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EUROPE/LATIN AMERICA REPORT

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WEST EUROPE/AEROSPACE

FRG PLANS INDEPENDENT NATIONAL SPACE AGENCY

Riesenhuber Receives Official Proposals

Frankfurt/Main FRANKFURTER ALLGEMEINE ZEITUNG in German 29 Feb 87 pp 7,8

[Text] Bonn, 28 Jan--Without delay the government should improve the basis on which it makes its decisions and the organization responsible for the FRG's participation in space travel. A report commissioned by Minister for Research and Technology Riesenhuber, which has just been published, is urging this. On Wednesday the Ministry for Research stated that Riesenhuber had requested the report because he felt that the forms of the organizations for German space travel, which had grown along historical lines, were no longer adequate.

The experts clearly favor a "German NASA" as the space agency for the new organization. The report states that if the FRG is not to be left behind in international programs and in technical developments in space travel, a decision about the most suitable solution must be made quickly.

Five models were studied and evaluated as organizational aids for German space travel, ranging from supplementing the present structure through a privately held company which would be responsible for the project and a publicly organized group, which would be responsible for the program and the project, to a Ministry for Air and Space Travel. The space agency is judged to be an extraordinarily efficient solution, in the event that work is carried out under industrial management and management conditions. Anyone wishing to establish a Ministry for Space Travel would also have to give this office the responsibility for air travel, in the opinion of the experts. The report itself does not make any judgment about a Ministry for Air and Space Travel, because this is felt to be a political question.

The recommendations for the fundamental reorganization are linked with criticism of German space policy. The report says that the FRG has not assumed the position in space travel that befits it as a result of its outstanding scientific, technical and economic potential, and also as a consequence of the high fees paid for international projects. The writers of the report noted an absence of any long-term plan for space travel and institutions to coordinate the goals of those involved in space travel, to draft the bases on which decisions are made and to implement decisions efficiently. The study refers to critical statements from German experts, according to which the

domestic space industry, as well as universities, major research institutions, the Max-Planck Society and the Frauenhofer Society did not see themselves as "having been adequately consulted" in the formulation of national plans for space travel. The lack of a suitable forum for the timely collection of proposals from all the experts was also criticized. The report therefore recommends an advisory gremium, with experts from science and industry and parties interested in future commercial space travel.

The report demands that the FRG catch up in space travel. Most noticeably in the FRG's neighbor France, space travel occupied a completely different position. The FRG was certainly paying a great amount for international space travel, but there were not enough independent proposals for projects from the German side. There was only constant reaction to proposals for other governments, whether it was the Ariane booster rocket initiated by Paris or the Hermes spaceplane. The decision in favor of the Columbus program as a cooperative project on the US manned space station had clearly been made as the result of political pressure from Washington.

The responsibility for the support and planning of German space travel lies with the Ministry for Research and Technology, as does the financing and running of the government's space program. The Ministry's job is to coordinate German space travel policy with the other offices. The central organization for research, operations and management is the German Research and Technology Institute for Air and Space Travel (DFVLR). It has the research capacity for flight medicine, space simulation, propulsion technology, communications technology and georesearch. The Ministry for Research uses the DFVLR in planning and implementing national programs. According to the report, this relationship is not without tension, the difficulties stemming from the structure of the DFLVR and the group responsible for the project, as well as from the overall forms of collaboration between the Ministry and the DFVLR.

The report's principal demands are: a tight organization for space travel, such as exists in other countries, reliable instruments for smooth cooperation, close coordination with science and industry in drafting a national plan for space travel which transcends individual offices and a space travel organization which will continuously update concrete plans for space travel, so that political will is transformed into effective strategies, measures and projects.

In initial reactions to the experts' report, the SPD sees itself vindicated in its view that there are considerable weaknesses in the policies and organization for German space travel. The spokesman on research policy for the FDP, Christian Lenzer, concludes from the report that a German space agency is inevitable.

Genscher Against Military Use

Hamburg DER SPIEGEL in German 12 Jan 87 pp 83-85

[Text] Whenever the discussion was about the leap into space, Minister for Foreign Affairs Genscher was always in the vanguard. For years he has been prodding his hesitant colleagues, Gerhard Stoltenberg and Heinz Riesenhuber, to participate at any cost in the planned construction of the European Columbus laboratory in the manned US space station.

But Genscher's pleasure in the space project, which will cost DM 12 billion, was soured recently. One day before Christmas, the German ambassador in Washington had sent a telegram to announce a new passenger to his boss: Caspar Weinberger, the US Secretary of Defense, wants to use the space station, which is initially supposed to be used exclusively for civilian purposes, for American SDI research.

The announcement of this intention, communicated to the partners as an inevitable fact, shocked Genscher abruptly out of his dreams of a peaceful advance into space by the Western industrial nations. If the US military is involved, as Genscher well knows, they will be in command.

Consequently, the Europeans, and primarily the Germans, would be directly involved in US president Ronald Reagan's controversial missile defense plans. Relations with Moscow, already tense because of verbal provocation by the chancellor in Bonn, would be further strained.

The hoped for economic and technological yield would also be lost. Where the Pentagon is a determining factor, secrecy is the primary commandment. The generals do not like the transfer of newly acquired knowledge to Europe. They are afraid that the Europeans, who are unreliable in American eyes, could pass on their knowledge to the Russians.

The Americans also do not intend to allow any discussion in the construction of the station or the selection of planned experiments. According to Pentagon department head Frank Gaffney, full international information or even the consent of international participants would be "unacceptable." The agreement between the Europeans and the Americans, originally planned for mid-January, on technology transfer and organization has been postponed on Weinberger's orders.

At the world economic summit meeting in London in 1984, everything had looked promising. President Reagan generously invited the industrial nations to profit from the United States' technological lead in space and to participate in construction of a space station for peaceful purposes. Japan, Canada and the European space agency (ESA) accepted.

The Americans are getting and paying for the lion's share. But at the beginning of 1985, chancellor Helmut Kohl promised more than DM 2 billion. The Bonn cabinet made the final decision dependent on a fair agreement on the commercial use of knowledge from space and on adequate codetermination in the choice of experiments.

The proviso was initially considered to be a matter of form. But in the discussion between the ESA and the US Space Agency NASA it quickly turned out that the partners had different ideas about fairness.

The US negotiators did not want to concede any free-flying space ship that could be detached from the station to their European counterparts. US law was in force on the entire space station, with all of the resulting consequences for access to possible patents.

In addition, the US partners reserved the commercially most important experiments on materials research under conditions of weightlessness for themselves. They assigned the bioscientific experiments to the Europeans.

The negotiators from NASA and ESA became involved in such serious disagreements that last year the Americans refused to continue talking to the delegates from the European Space Agency. The ministers for research had to intervene personally to get the discussions under way again. After stubborn back and forth wrangling they are supposed to be finally concluded at the end of this month with a compromise.

For the entire time, Pentagon chief Weinberger had shown no interest in the space station. But now he suddenly discovered that the Europeans' desire to participate in decisions could disturb his plans. In order to prevent any misunderstandings among the partners, Weinberger announced his plans at the last minute.

Genscher's observers in Washington telegraphed to their boss that it had been perfectly clear to the hawks in Reagan's team that the Europeans would scream. Weinberger's officials argued that this reaction proved precisely how necessary it was to secure military access to the civilian space station.

Originally the Pentagon chief had said that he did not need the planned space station for his militaristic space plans. He intended to use the space shuttle, which already seemed to be fully operational for space flights.

But after a team of astronauts in the space shuttle Challenger was incinerated after liftoff over Florida in January 1986, Weinberger's concerns began. Additional shuttle flights were delayed, and the number of planned liftoffs was drastically cut. Then Weinberger discovered the possibilities of the space station.

It does not trouble the arms-obsessed secretary that the station is supposed to serve exclusively peaceful purposes. Genscher's experts in Washington discovered that he is seeking support from an international "space treaty." According to this treaty, all "non-aggressive" activities are "peaceful." No problem: after all, SDI is a missile defense system.

Washington had already embarrassed the Europeans twice with this definition. The transatlantic partners used the Spacelab, which had been built by the Europeans and then donated to NASA after being used once, quite unabashedly for SDI experiments.

Against the wishes of Minister for Research Riesenhuber, the Americans did as they pleased with the SDI mission, built with German tax money and put into orbit by NASA: with it they launched the apparently urgently needed spy satellite GLOMR over Latin America.

Since it is clear that Weinberger wants to use the space station for military experiments, Minister for Foreign Affairs Genscher is racking his brains for a way to extricate himself from the "gag treaties." He openly puts up for consideration that if necessary the Europeans could venture the step into space without the Americans.

But Genscher knows that his proposal does not offer a true alternative. Going it alone is technically not possible, because the Germans and the French do not have enough money and knowledge to complete a system of rockets, space ships and the space station by the year 2000 without assistance from the United States.

Politically the way out is not practicable. The German Minister for Foreign Affairs cannot afford to distance himself from the pretentious joint project because of research into a weapons system that his chancellor and Franz Josef Strauss have already endorsed.

Foreign Ministry Backs Proposals

Frankfurt/Main FRANKFURTER ALLGEMEINE ZEITUNG in German 10 Jan 87 p 2

[Text] Bonn, 9 Jan--Negotiations between Americans and Europeans about collaboration in a jointly-manned space station are encountering additional difficulties as the result of differences of opinion about using the station for military research. Since the new year started, the Federal government has been able to clarify Washington's position in diplomatic contacts for further consultations between the governments involved and between the European space agency (ESA) and the American space agency (NASA). The current situation as Bonn understands it is that the Americans want complete freedom of disposition for military research on the station. The Europeans would not be in a position to contest research for military purposes in the part of the collaboration that the Americans dominate. On the other hand, Bonn says, the Europeans would insist on freedom of action for their part in the joint project. This included the non-negotiable stance that no military research would be carried out in the European section. This was excluded from a purely judicial standpoint, because the ESA treaty excluded military research as a basis for European cooperation.

In the early phase of the negotiations, the Europeans tried to reach an agreement about US concessions on restrictions on military research in their part of the project. The US Department of Defense has now again expressed its concern that the freedom of the American partner could be restricted. The Pentagon reiterated its point of view that it could not be bound by restrictions in research for military purposes.

Negotiations on European-American collaboration have come to a halt on the question whether the responsibility and the power to make decisions for the entire project should lie with NASA in cases of differences of opinion and problems in interpretation. The US negotiators have so far not budged from this demand. But the European governments objected that this would not meet with President Reagan's call for a "fair partnership" in space. According to information from Washington, the US State Department hopes that the discussions with the other governments can be concluded in the spring.

A compromise for independent European research is being sought in participation information from Washington, the US State Department is hoping that discussions with the other governments can be concluded in the early part of the year.

A compromise for independent European research is being sought in participation in a two-part collaborative project. The European contribution is to consist of a module that is solidly attached to the space station and one that can orbit freely about it, in which work would be conducted under conditions of total European sovereignty.

The Ministry for Foreign Affairs points out that crucial decisions would have to be made in 1987, not only for this cooperative project but also for independent European projects, such as the Hermes spaceplane. Like the Ministry for Research and Technology, the Ministry for Foreign Affairs considers it a necessity to reorganize German space travel activities. In this respect, a report commissioned by Minister for Research Riesenhuber is now available, in which apparently proposals are put forward for more effective organizational forms, such as a national space agency. The Ministry for Foreign Affairs considers an agency of this kind urgently necessary.

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CSO: 3698/289

IGNITER TESTING DELAYS ARIANE

Paris AFP SCIENCES in French 29 Jan 87 p 8

[Text] Paris--It is still too early to set a date for resumption of Ariane launches, according to the 28 January statement of Jean Sollier, chairman of SEP [European Propulsion Company], the firm that manufactures the European satellite launcher engines.

The cold wave has caused delays in the long series of tests called for by changes in the third-stage igniter responsible for the 31 May failure of the eighteenth launch, since testing could only be resumed late in the afternoon of 27 January.

Although the first test following the improvement in weather conditions on the 27th lasted 100 seconds, it was not entirely satisfactory, due to the failure of the equipment for testing limit-condition operation of the engine for the V-19 (nineteenth) launch. "We will have to push the date for launch resumption back," Mr Sollier said.

"Customers of Arianespace, which markets the launcher, are kept abreast of the tests as they happen and understand this quite well. The purpose of the 27 January test was to see how the engine ignited. It ignited properly, but we were unable to carry out the turbopump limit-condition tests," he added.

Several types of tests have been under way for the last 6 months. Some 15 more are left before the third-stage V-19 launcher can be given the go-ahead.

Arianespace, ESA [European Space Agency], and SEP technical experts have established a program to determine the limit conditions for flight operation of this engine. This program must be completed. Meanwhile, tests will continue on the new igniter, ready since 31 May. These tests are designed to provide an indepth understanding of the new igniter's operation and to compare it to that of its predecessor.

The goal of all these tests is to make it possible to provide Arianespace customers with very good assurances that their satellites will reach their scheduled orbits, as promised.

A second flight simulation testing installation just completed at the Vernon factory (Eure department) will make it possible to speed up these tests, as

well as other longer-term tests involving all Ariane third-stage engines, to take place over a two-year period and to cost from 700 million to 1 billion francs. The new installation should be operational in early February.

For SEP, the 31 May failure of the V-18 launch meant a 350-million-franc loss in income. "But we will make up for it," Mr Sollier emphasized. "We learn a lot even from the failures. It is even basic to the high technology field we are in. We have developed a policy of international cooperation with Italy, Sweden, and West Germany. There will soon be an international testing team at Vernon."

13014/12859
CSO: 3698/287

FRENCH SPACE MARKET FOR SMALL COMPANIES ASSESSED

French Industry's Share

Paris L'USINE NOUVELLE in French 4 Dec 86 pp 26-27

[Article by Jean Pierre Casamayou: "Small- and Medium-Sized Space Industries"; first paragraph is L'USINE NOUVELLE introduction]

[Text] A Fr 25-billion European market in 1988, one-third of which will go to French industry! Equipment suppliers, specialists, and subcontractors are already waiting in the wings, alongside the big four.

Fr 25 billion! That will be the size of the European space market in 1988 as projected by the European Space Agency. These prospects make industrialists (both large and small) dream as they meet this week in Bordeaux for the first Technospace exhibition. Even more important is the fact that one-third of this amount is expected to go to French industry, where nearly 10,000 persons are directly already involved in space projects. The four space giants (Aerospatiale, Matra, SEP [European Propulsion Company], and Alcatel Espace) are the major employers, but space still provides work for 4,000 people in medium-sized companies. Equipment suppliers, specialist industries, and subcontractors are often small- and medium-sized industries (PMI) or companies (PME). Some of the latter cash in on very technical disciplines such as optics where Angenieux and Reosc have acquired fame.

With only about 40 people and under the leadership of Dominique de Ponteves, Reosc has shown itself superior to the large companies. Its optics are used in SPOT's HRV [high visual resolution] cameras and in the Hipparcos telescope. Reosc has even succeeded in marketing special mirrors used in American space defense experiments.

This achievement is almost unparalleled as PMI's are rarely involved in satellite projects. They more frequently provide data processing services--Eurosoft or International Computer Sciences, for example--or even ground systems. In this sector, the firm Ateliers et Constructions du Centre has very successfully diversified into "space" without abandoning its traditional activity, i.e., mechanical engineering. It supplies most of the antenna supports for the ground stations in France and Guyana. "Space already represents 7 percent of our turnover and provides employment to some 40 people," explains the director. "We are even beginning to export our products."

Another typical activity of PMI's consist in selling space spin-offs. Thus, CEIS Espace of Toulouse was set up as a result of a space-related service: satellite detection. This small company with a staff of 60 manufactures beacons, terminals, and Argos stations. Propelled by this momentum, it is also working on an emergency beacon for the new Sarsat system for orbital assistance. Here, however, it will be in competition with Serpe, another PME from Lorient, which has just entered into this adventure. Serpe, an electronics firm specializing in protection barriers and employing 40 people, has even created a subsidiary especially for this purpose. The stakes are particularly high for these companies, because if regulations decide in their favor, 15,000 French ships will need to be equipped with these emergency beacons: a Fr 1.5-billion market!

Thus, PMI's take a greater interest in the offshoots of the conquest of space than in direct participation in the large programs. The CNES has understood this very clearly: It created Novespace, a company which promotes space-related technologies in industry. It offers a kind of space technology stock exchange for everyday applications.

Modul'air is the first PMI that has resulted from this initiative. This company intends to build highly pressurized structures, capable of being used as pillars (for porch roofs and greenhouses) with the soft materials used in the manufacture of certain scientific balloons. Jean-Pierre Fouquet, chief executive officer of Novespace, thinks that such initiatives have a promising future: "It is better to benefit from a technology transfer and create one's own company than to remain a subcontractor subjected to the caprice of the contractors."

Bordeaux's Space Industry

Paris L'USINE NOUVELLE in French 4 Dec 86 p 26

[Article by Gerard Mutaeud: "The Aquitaine Well Positioned for Space Conquest"]

[Text] Bordeaux--In the Aquitaine region the presence of the major aerospace contractors has given rise to a web of PMI's specializing in electronics and precision mechanics. With the launch of the Hermes program, these companies are particularly well positioned to embark upon the space adventure.

The participation of the Etablissements Fresson of Talence and Lagrange of Blanquefort in the Technospace Exhibition was primarily to find markets for their high-tech skills in machined mechanical parts for space applications. "Whether the parts that we manufacture travel in the atmosphere or stratosphere matters little to us," says Michele Fresson, "the technical constraints remain the same."

CARME (Center for Applications and Research in Electronic Microscopy) is the only locally based company which has worked regularly for the space industry for amost 3 years now. It specializes in quality analysis and failure diagnostics of electronic components.

This niche gives it major French space industries as customers (Matra and Thomson, for example). Jacques Kozan, marketing manager at CARME, explains that space currently represents 15 percent of its electronics activities.

With Fr 8 million in 1986 revenues of which 55 percent comes from electronics, CARME has great ambitions for the future. "We think that our sales volume will double in the space business next year," states Jacques Kozan. "The positive effects of the Hermes program are already beginning to be felt." For 1987, CARME has announced the creation of a department for analysis and description of materials for space applications. CARME, located at La Teste (Gironde), will increase its present 22-member staff to 35 people.

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BRIEFS

SWEDEN GUIDES JAPANESE SATELLITE--The space center Esrange at Kiruna is getting increasing numbers of assignments. At the moment they are helping with the guidance of a recently launched Japanese satellite, and reportedly there are several similar assignments to follow. "We have contact with the Japanese satellite 5-6 times a day," says Asa Harila from the Esrange Satellite Control and tells us that the control mission agreement is valid through ca. 13 March. The satellite is called MOS 1 [Marine Observation Satellite] and it is used to monitor the ocean surfaces. It takes pictures--showing streams and temperatures--which can be utilized by the Japanese fishing fleet. "Our task is to establish contact with the satellite when it passes over and to transmit that data to Toulouse, France, which in turn transmits it to Japan," says Asa Hallin (sic). In this context Esrange is a so-called transparent station, as they say in 'space-Swedish', i.e. it only functions as a transmitter of data. The reason for Japan wanting help from Esrange is the fact that MOS 1 is a polar satellite, i.e. it passes over the poles. Thus Kiruna and Esrange are in an advantageous position to receive satellite signals. Several similar assignments are reportedly going to be brought into operation. Both Japan and China are showing interest in this type of collaboration. [Text] [Stockholm NY TEKNIK in Swedish 12 Mar 87 p 10]

CSO:3698/370

BRIEFS

HERBICIDE-RESISTANT PLANTS--Brussels--A Belgian company specializing in genetic engineering announced on 22 January that it has perfected a new technology to concentrate in certain selected plants the action of a herbicide thereby dramatically increasing its effectiveness. This discovery, the Plant Genetic System (PGS), completely destroys weeds only. It should therefore reduce costs of spraying industrial crops such as sugar beets, tomatoes or wheat, announced company executives during a press conference in Brussels. The PGS research team has developed plants which are resistant to phosphinotricine, the active ingredient of the broad spectrum herbicide "BASTA R" produced by the West German Hoechst group. This herbicide is harmless to livestock and humans. [Text] [Paris AFP SCIENCES in French 22 Jan 87 p 64] 12798/9869

CSO: 3698/261

BRIEFS

NEW SWISS ALLOY SUPERCONDUCTOR--Geneva--A new superconductor alloy that becomes superconductive at -233 degrees and, according to a specialist, "represents a gigantic step forward," has been discovered by a Swiss scientist, Prof Alexandre Muller, who presented the results of his research 22 January at the University of Geneva. Discovered in 1911, superconductivity is the property of certain alloys of completely ceasing to resist the passage of electricity at very low temperatures. Currently, the transmission of electric current must overcome metal resistivity, resulting in a power dissipation. Professor Muller's discovery could have important consequences particularly in the fields of electrical transmission, medicine, and computer science. Michel Decroux, head of research at the Geneva School of Physics and responsible for confirming the results obtained by Mr Muller, who works at IBM's Zurich center, explained to AFP, "Until now, you had to go down to -250 degrees for the alloy niobe-germanium to reach zero resistivity." "To obtain such low temperatures, cooling fluids such as liquid helium or hydrogen had to be used," Mr Decroux stated. "This alloy, composed of lanthanum, strontium, copper, and oxygen, becomes a superconductor at -233 degrees and can be cooled to this temperature using neon, which becomes liquid at -246 degrees." This new cooling technology will be both less expensive and more effective, according to Mr Decroux. One possible application is in the superconductors used in medicine for nuclear magnetic resonance scanners. Another is in computers, where it will allow greatly increased memory capacity. [Text] [Paris AFP SCIENCES in French 29 Jan 87 p 29] 13014/12859

SPAIN: FUJITSU AIMS HIGH--Madrid--"The decision process in a Japanese company is very lengthy, but once we decide, we are very fast." Mr Chiaki Sugishima, Fujitsu's deputy advisor in Spain, could not have given a clearer warning of Fujitsu's intentions there. The goal of the 5-year plan begun in 1986 is to make FESA (Fujitsu Spain Corporation), No 2 company in the Spanish computer market. For 1987, FESA (whose new president is Mr Adrian Piera) has set a target of increasing sales in Spain by 25 percent over 1986, to 22.3 billion pesetas (171.5 million dollars at 130 pesetas to the dollar). FESA expects a business volume of 25 billion pesetas in 1989. Japan's number one computer firm is aiming high, especially since it only really began to attack the Spanish market a little less than 2 years ago. In July 1985, Fujitsu signed a joint venture agreement to form a computer company with Secoinsa, owned by the government holding company National Industry Institute (INI) until its purchase in March 1985 by the semiprivate Spanish telecommunications firm, Telefonica. Under the terms of the agreement, 60 percent of the capital is held by Fujitsu and the rest by Telefonica. The big advantage of the Spanish market compared

to other European countries is that Spain has hardly any domestic electronics industry to protect. The big names in Japanese industry, like Nissan, Honda, Sony, Yamaha, Suzuki, and Matsushita (National Panasonic) have started to get into the action in recent years and have cast their eyes on Spain, which one European diplomat predicted might be the "California" of Europe by the year 2000. [Paris AFP SCIENCES in French 29 Jan 87 pp 26-27] 13014/12859

CSO: 3698/287

BRUSSELS' ROBOTEX '86 HIGHLIGHTED

Milan TECNOLOGIE MECCANICHE in Italian Nov 86 pp 212-217

[Article by Aurelio Fanoni: "At Robotex '86: European Robotics on Display"]

[Text] Robotex: This was the name given this year to the annual robotics show that is held in conjunction with the ISIR, the International Symposium on Industrial Robotics.

And whereas last year in Tokyo the show was practically a presentation of Japanese robotics, this year in Brussels the connotation it conveyed was clearly a European one.

Let us hasten to say that the show was not one of particular immensity: Especially if this Show was intended to be the big event of the robotics year, our "homegrown" 7 NC Industrial Robot found nothing in it to rouse its envy.

Are the builders perhaps beginning to wonder about the real value of these shows, which are now becoming proliferative and may thus be diminishing their own importance and, in turn, the market?

Nevertheless, this show can be considered original in the respect that the traditional exhibitors of robots were flanked by a sizable number of firms in other categories, many of them producers not of equipment but rather of services.

Substantial, in fact, was the number of firms operating in the area of systems engineering, not from the standpoint of construction of the hardware, but rather from that of supplying the engineering for the integration of robots with other machines.

Numerous also were the examples of simulation software for robotized cells, that could be run on computers of various sizes, from small IBM PC's to sophisticated CAD's when installed on special-purpose computers.

For the first time, moreover, at least as far as I know, a complete robotics firm, not in sound financial health, was being offered for sale.

And this latter fact should provide food for thought, because it is a tangible example of the many enthusiasms that have been replaced by bitter disappointments, in the wake of the initial years of optimistic expectations.

This all confirms the fact that robotics pays returns only on large-scale production or particularly brilliant ideas, while foreordaining to severe economic difficulties all those who encase themselves in the construction of robots, secure in the view that robots are but assemblies of arms and joints governed by a numerical control and that the building of a few tens of them will suffice to cover the costs of the project.

Another original aspect of this show consisted of the incredible lack of respect for safety precautions. Suffice it to consider that a GMF robot was wafting a big welding gun at a speed of about 1 meter/second above the very noses, so to speak, of the spectators, without any physical barrier whatever to impede an extemporaneous dunking of the gun over the heads of the visitors.

And of all things, though I'm not sure we should rejoice in it, there was the advent of soubrettes--yes, dancers--to support the debut of a new robot put on the market by one of the world's biggest builders of these machines.

The new products shown were decidedly many. Outstanding among them were DEA's new multiple-arm-robot control system; the family founder of a new generation of articulated robots by ASEA; an integrated robot and manipulator system developed by Yaskawa; and a special type of robot, designed by Renault, for laser machining operations.

There was a pair of mobile robots on wheels, one of which was being used in an office-cleaning example.

A listing of the various new products should also include a number of "cell controllers," which are actually island control computers.

Our own domestic robot industry was certainly not conspicuous for its presence: Its sole exponent was DEA.

But let's have a more detailed look at what this show actually offered the visitor.

We start with the exhibit that highlighted Cincinnati robots; tinier in size it could not be...

The largest one, on the other hand, was ASEA's, in which, in addition to the occasional presence of dancers and of eggs being broken in the smoke over a stage setting of sorts, the IRB 2000--a new articulated 6-axis robot that can handle 10 kg within a work space over 3 meters in diameter and up to a height of almost 2 and 1/2 meters above ground--was put through its paces.

Together with the new machine, ASEA exhibited also the new S3 control, which was designed for the IRB 2000 and which, in addition to operating on alternating current, provides an example of large-scale integration, bringing together on a single card all the hardware and software functions except, obviously, those of the power components, which remain modular.

There were also a few concrete examples of applied robotics. Exhibited was a live production line that in about 17 seconds assembled an automotive headlight, using Scara robots, pendulumtype robots, and articulated robots, specifically the new IRB 2000. There was a sealer-and-bonder extrusion workstation featuring variable capacity and closed-loop control. There was also an arc-welding robot with a Lasertrack seam-chasing sensor by means of which the start of a seam can be searched for and, when located, the welding operation performed regardless of the course followed by the seam in space.

Perhaps second in order of size was the presence of Renault, which exhibited, among others, the Scara robot and the Y28 robot in an upside-down version equipped for the extrusion of sealer and the door mechanism of the R5 car. Renault's exhibit also included one of the more significant innovations: the so-called Laser Robot. This is a 5-axis articulated system, whose first degree of freedom consists of a longitudinal traverse slide. Particularly worthy of note is the total integration of the laser beam transport system for powers up to 2.5 kW.

GMF's presence was also impressive, certainly not reflecting the problems that have beset the company in the United States in the wake of the drastic cutbacks in the General Motors robotization program.

Almost the entire product line was exhibited, without, however, any world-shaking innovations: From the portal-mounted robot developed together with Niko to the robot for applications in the "clean room"; from the painting robot, the only electrically-driven one at present, to the robot equipped with laser under the now well-known, even though not widely diffused, Laserflex system.

A sophisticated system consisting of a servo-controlled manipulator linked to a type V12 articulated and suspended robot was exhibited at the Yaskawa stand, together with the L60 spot-welding robot, featuring an interesting wrist with ball-joint and 60-kg capacity.

Kuka exhibited applicative examples of screw-driving and continuous-welding operations involving a dually equipped, automatic-tool-change gripper. In particular, a laser device designed to be mounted on the robot's wrist, together with the welding torch, was shown simulating the chasing of a seam.

This sensor's very large size, however, makes somewhat doubtful its applicability in those cases where the required welds are not easily accessible.

IGM exhibited a Lima Type RT280-6 robot in a suspended version, shown traversing a run some 10 meters long.

A manipulator, also produced by IGM, was shown completing the island.

The station was not shown in operation, however; neither were the robots of the Romat series which were part of the Cloos exhibit, where the manipulators were shown in the form of small-scale models.

Also present in the welding field was ESAB, exhibiting direct-learning manipulators of the MAC series, and the new ASEA IRB 2000 robot integrated into a complete operating station that included servo-controlled manipulators and pulsed-arc current generators.

Manutec, a recent version of the prior Mantec, exhibited the classic R3 articulated robot and the Scara H5.

The latter has its outermost arm "right-angled"; that is, it is not straight as are those of most of its competitors, but rather curved, so as to cover, according to the builder, an optimal working area.

As exhibited, the M5 robot was being used to insert valves in automobile engine cylinder heads.

As regards the structure of the machines, contrary to last year's show in Tokyo, there were no particular innovations. The Scara-type robots, however, showed a marked trend towards increasing complexity and sophistication, to the point of their becoming an alternative to machines with an articulated structure.

This trend, however, is advancing to the detriment of two of their original characteristics: Simplicity and economy.

A case in point is the American firm Intelledex's robot Assembly 2 which, although on the one hand it provides outstanding performance characteristics, on the other hand, it does so at costs that are far from contained.

As regards the interlocking of machine tools, the Cartesian-displacement, suspended-rails type of structure is enjoying notable success.

In this area, Reis exhibited the Reis-Linear-Robot, a rather simple 3-axis machine, whose axes can be pneumatically, hydraulically or electrically controlled and which can cover a considerable working area.

Its payload capacity ranges between 3 and 15 kg.

In the area of control units, in addition to the aforementioned ASEA S3, which after all is inseparably tied to the IRB 2000 robot, DEA showed a decidedly advanced system. The new system, designated the RCS5, or RCS10,

depending on the number of operative axes, is characterized by the attention paid by its designers to the control of its peripherals. The system provides a remoting capability; that is, placement at a distance of the input/output control units, which are connected to the director unit by means of bighted cables.

Off-line programming terminals and computers of a higher hierarchical level are also interconnectable in serial operation.

The core of the system is a J11 computer aided by 8088 and 8087 microprocessors.

The DEA exhibit also displayed--in addition to control units--cylindrical robots and a demonstration assembly island featuring a bidimensional machine-vision system.

As mentioned earlier herein, various engineering firms and scholastic institutes were offering their services.

Outstanding among the former was Fabricom, a Belgian firm that operates in many engineering fields, and cites broad experience gained in the installation of the robots of various builders, ranging from IBM to KUKA, etc.

But Tecnomatix merits special mention.

This Belgian firm has acquired considerable experience in the study of applications in the areas of foundry dressing-off operations, manipulation, and even vision systems.

At the Show, this firm exhibited the Robocad system produced by Silicon Graphics. This system attracted considerable interest because of the ease with which the study of robotized islands can be modeled, accurately simulating even their operative cycle.

Owing to the introducibility of the physical parameters of the robots, this system's software makes it possible to calculate trajectories and displacement times with a maximum approximation within around 10 percent.

One of the principal limitations, however, is still the need to define a model for each device introduced into the planning: If, for example, 10 pneumatic cylinders differ from each other in size alone, the parameters cannot be varied; rather, 10 different models must be introduced.

One aspect that this Show certainly failed to develop in depth was that of sensors: Except for the aforementioned ones for seeking and chasing welding joints, the presence of sensors was extremely limited, and the vision systems exhibited, besides being very few, were merely bidimensional.

The presence of the components sector was virtually nil, with the exception of SKF, which exhibited its, after all, well-known modular coupling and transport systems.

In conclusion, despite what should be the standing of this Fair as the robotics world's most significant, this particular exposition was certainly not especially interesting.

Who knows but that the time may have come for an inversion of trend: Fairs will have to be less sectorial and more interdisciplinary, without reverting to the lack of specificity that characterized them in times past, to be able to attract a public more densely populated by potential buyers and thus be more of an attraction to exhibitors as well, who are finding it very difficult today to justify substantial investments on which economic returns are highly doubtful.

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CSO: 3698/268

ITALIAN NUMERICALLY CONTROLLED MACHINE TOOL INDUSTRY

Milan AUTOMAZIONE INTEGRATA in Italian Jul 86 pp 50-61

[Article: "Diffusion of Numerical Control in Italy" published under section heading "Censimento 1985©"; the source term "censimento©" is translated herein as "copyrighted survey"; full text precedes set of Tables 1-9, only some of which are cited in text, and related set of graphs, Figs 1-8, none of which are cited]

[Text] The eithteenth copyrighted survey is published this year concomitantly with the BIMU, once again highlighting its role as a point of reference for those engaged in this field of work. We express our sincere thanks to all those who, by completing our questionnaires, made possible the drawing up of the tabulations which follow.

Figures Compiled From the TECNICHE NUOVE Annual Survey

Results of the Copyrighted Survey

The cautiously optimistic projections with which we concluded our comments last year on the 1984 Survey have materialized almost to the very figure.

The number of MU/CN's [numerically-controlled machine tools] installed [in 1985] totaled 2,269, up 24.5 percent with respect to 1984 (1,822 units), which had in turn topped the 1983 figure (1,315 units) by 38.5 percent.

Italian production of MU/CN's totaled 2,554 units, up 22.2 percent over the figure for 1984 (2,090 units), which had in turn surpassed the 1983 figure (1,710 units) by an identical 22.2 percent.

Imports of foreign MU/CN's (792 units) rose substantially (40.2 percent) with respect to the 1984 figure (565 units), which already represented a gain of 48.7 percent over the 1983 figure (380 units).

Exports of Italian MU/CN's totaled 1,077 units, up 29.3 percent over the total for 1984 (833 units), which in turn had slightly topped the 1983 figure (775 units) by 7.5 percent. In terms of number of units, exports amounted to 42.2 percent of Italian production, a slight decline relative to 1984 (45.7 percent) and 1983 (45.3 percent).

Domestic demand for Italian MU/CN's totaled 1,477 units in 1985, up 17.5 percent relative to 1985 (1,257 units), which in turn was up +34.4 percent over 1983 (935 units).

Table 4 shows lathes in a persistent downslide: The ratio of lathes to total MU/CN installations plummeted further to 35.3 percent in 1985 from 40.8 percent in 1984, from 44.5 percent in 1983, from 51.5 percent in 1982.

In this regard, a discussion would be worthwhile as to the meaning of the term "lathe" as understood today, but we will undoubtedly have an opportunity to do this at some other time.

Table 6 indicates that our market for lathes drew very heavily on imports (365 units versus 250 in 1984 and 168 in 1983).

Table 1 shows that the FRG [Federal Republic of Germany] occupies the number one position among our export markets, followed closely by France.

The U. S. and Asiatic markets continue substantially "off limits" for Italy considering relative market sizes, particularly as regards the first of these.

Table 2, as compared to that for 1984, shows a very marked rise in installations in the "Automobiles and Motors" sector (331 units versus 149 the previous year); the "Weapons and Arsenals" sector, with 211 units, shows a decline relative to 1984 (259 units).

Table 3 bis shows that machines of foreign manufacture have progressed considerably in the "Automobiles and Motors" sector (153 units versus 64 in 1984); sharp increases were also registered in the "Transportation," "Construction and Agricultural Machines," "Machine Tools," "Other Machines Except Electrical," "Communications," and "Woodworking Machines" sectors.

Table 3, relative to the Italian market served by imported MU/CN's, when compared with the same tabulation for 1984, confirms the steady progress being made by Japan: 176 MU/CN's in 1985, 118 in 1984, 85 in 1983, 74 in 1982, and 33 in 1981.

Among Japanese MU/CN's the demand for lathes (115 units) topped all other categories, followed at some distance behind by machining centers (28 units) and boring machines (27 units).

The FRG, with 254 units in 1985 versus 186 in 1984 and 121 in 1983, continued as the principal supplier of the Italian market, followed by Japan, which now enjoys a 22.2-percent share of our import market.

Production, Importation, NC Machine-Tool Population

Tables 4, 5 and 6 recapitulate by machine families the figures tabulated in the preceding tables.

The MU/CN's of foreign manufacture installed in Italy in 1984 (Table 6) represent 34.9 percent of total installations. In preceding years the situation was as follows: 31 percent in 1984; 28.9 percent in 1983; 25.4 percent in 1982, and 21.7 percent in 1981. It can also be concluded that the long crisis also eroded the domestic market positions of our nationally-produced MU/CN's.

Examining family by family, it is seen that MU/CN's of foreign manufacture represent 26.1 percent of our drilling machines, 21.7 percent of our milling machines, 45.6 percent of our lathes, 49.2 percent of our boring machines, 24.9 percent of our machining centers, and 59.4 percent of our "other," comprised mainly of (see Table 3) spot welders, sheet metal machines and grinders (at some distance behind).

As for our domestic MU/CN population (Table 9), it has attained 18,331 units as projected by us last year.

Forecasts for 1986

Our forecasts are based on Tables 7 and 8 and on perceptible signals emanating from the market, which appears to be livelier this year than last. Italian builders have obtained orders for 2,345 units (the corresponding figure for 1985 was 1,892); orders placed on foreign builders have totaled 597 (the corresponding 1985 figure was 450).

It appears that 1986 installation figures will show a gain over those for 1985, with MU/CN installations in Italy attaining a total of between 2,600 and 2,800 units. As a result, Italy's MU/CN population as of 31 December 1986 can be expected to reach a total of some 21,000 units.

[End of text; tables and graphs follow]:

Introduction to Tables 1-3 bis, 7, 8

Following is Key to numbered items (left-hand column) in above-indicated Tables:

1. Horizontal turret lathes.
2. Horizontal automatic-tool-changer lathes.
3. Vertical lathes.
4. Other.
5. Table-mounted horizontal boring machines.
6. Stantion-mounted horizontal boring machines.
7. Horizontal jig borers.
8. Vertical jig borers.
9. Jig borers (not installed).
10. Production boring machines.
11. Single-piece drilling machines.
12. Turret-type drilling machines.
13. Automatic-tool-changer vertical drilling machines.
14. Radial drills.
15. Other boring and drilling machines.
16. Single-piece vertical millers.
17. Turret-type vertical millers.
18. Single-piece horizontal millers.
19. Turret-type horizontal millers.
20. Profiling millers.
21. Boring millers.
22. Planer-type millers.
23. Special-purpose millers.
24. Other vertical boring millers.
25. Single-piece vertical machining centers.
26. Turret-type vertical machining centers.
27. Automatic-tool-changer vertical machining centers.
28. Single-piece horizontal machining centers.
29. Turret-type horizontal machining centers.
30. Automatic-tool-changer horizontal machining centers.
31. Grinders.
32. Miscellaneous spot welders.
33. Perforating punch presses.
34. Woodworking machines.
35. Sheet-metal machines.
36. Automatic punching machines.

Table 1

Italian MU/CN Production - 1985
(Number of Units)

[For Key to following numbered items, see preceding Introduction]

		Country of Destination										
		Italy	United States	Great Britain	Germany	France	E. European Countries	Rest of E. Europe	Asia	Americas excl. United States	Other	Totals by Item	Totals by Group
1. Torni orizzontali a torretta		353	13	20	29	31	3	29	3	16	7	504	
2. Torni orizzontali automatic tool changer		2										2	
3. Torni verticali		53	22	15	56	28	9	8	4	11	8	214	
4. Altri		28		20	50	30				9	23	160	8 60
5. Alesatrici orizzontali a tavola		37			7	11		4		1	11	71	
6. Alesatrici orizzontali a montante		17			15	1		4		8		45	
7. Jig borer orizzontale													
8. Jig borer verticale													
9. Alesatrici tracciatrici (non installata)		10		10		9						29	
10. Alesatrici da produzione													145
11. Foratrici singole		8										8	
12. Foratrici a torretta		34	5	8	4	1		4				56	
13. Foratrici verticali automatic tool changer		7			10	11		4				32	
14. Trapani radiali		13			13			13				39	
15. Altre foratrici alesatrici		3										3	138
16. Fresatrici verticali singole		112			23	4		20		2	4	165	
17. Fresatrici verticali a torretta		7				10		1	1			19	
18. Fresatrici orizzontali singole		75		1	10	1		19			1	107	
19. Fresatrici orizzontali a torretta	-	12										12	
20. Fresatrici per profili		26	1	10			3			3		43	
21. Fresatrici alesatrici		147		20	7	11	12	17			1	215	
22. Fresatrici tipo piallatrice					2		2					4	
23. Fresatrici speciali		17		4	7	13	3	2				46	
24. Altre fresatrici alesatrici verticali		11										11	622
25. Machining center verticali singoli		39				1						40	
26. Machining center verticali a torretta		78			22		8					108	
27. Machining center verticali automatic tool changer		120		10	1	24	8	1				164	
28. Machining center orizzontali singoli		33				3	1					37	
29. Machining center orizzontali a torretta		1					3					4	
30. Machining center orizzontali automatic tool changer		180	3	10	22	20	30	24		4	5	298	652
31. Rettificatrici		46	6	3	10			20	4	2		91	
32. Varie puntatrici													
33. Presse punzonatrici													
34. Macchine per carpenteria		8		10			9					27	
35. Macchine per lamiera													
36. Punzonatrici automatiche													118
Totale		1477	50	141	266	231	83	178	12	56	60		2554

* atc = automatic tool changer

Table 2

Number of Italian-Manufactured MU/CN's Sold in 1985

[For Key to following numbered items, see Introduction preceding Table 1]

	Destination of MU/CN's - Type of Firm																					
	Aircraft & Motors	Automobiles & Motors	Transportation except Automotive	Tractors	Construction & Agricultural Machinery	Machine Tools	Other Machines except Electrical	Electrical Machines & Plants	Communications	Instrumentation	Weapons/Arsenals	Dies	Schools	Woodworking Machines	Machines for Plastic Materials	Textile Machines	Compressors	Pumps	Carpentry	Metallic Furniture	Other	Totals by Item	Totals by Group
1. Torni orizzontali a torretta	27	63	10	9	9	15	22	21	13	5	73	31	9	30	17	38	13	38	10	7	44	504	
2. Torni orizz. automatic tool changer											1	1										2	
3. Torni verticali	7	23	10	6	5	4	7	14	12	13	18	15	3	23	8	13	4	6	10	3	10	214	
4. Altri	2	17	3	2	3		16	1	2	1	5	3	2	2	2		2				97	160	880
5. Alesatrici orizzontali a tavola	2	15	2	1	4	4	15	1	4	1	4	1		4	1	2		2	1		7	71	
6. Alesatrici orizzontali a montante		5	1	1	2	5	4	5	1	4	4	2	1		2	1		2			5	45	
7. Jig borer orizzontale																							
8. Jig borer verticale																							
9. Alesatrici tracciatrici	5	5				3		2		2	3		2	2	3			2				29	
10. Alesatrici da produzione																							145
11. Foratrici singole	3				1	1			2							1						8	
12. Foratrici a torretta	5	10	2	4	2		3	2	3	3	2	4		1	4	3	3		2	2	1	56	
13. Foratrici verticali automatic tool changer	2	2	1	1	1		1	2			2	1	1			1		2	1	2	12	32	
14. Trapani radiali		11		2		5	2	1	5	2	2			3		2	2		2			39	
15. Altre foratrici alesatrici		2																			1	3	138
16. Fresatrici verticali singole	5	12	6	3	4	3	7	8			14	56	9	3	5	4				8	18	165	
17. Fresatrici verticali a torretta		2	3				1				3	4					1				5	19	
18. Fresatrici orizzontali singole	3	26	7	2	2	12	4	1	8	2	3	12	2	3	2	3	2		4	1	8	107	
19. Fresatrici orizzontali a torretta	1	5			1		1					1				1					2	12	
20. Fresatrici per profili	1	11	3	3	8	2	3	3		2	1	2			2				1		1	43	
21. Fresatrici alesatrici	15	12	13	2	10	14	9	15	4	4	21	15	19	5	9	7	8	2	7	2	22	215	
22. Fresatrici tipo piallatrice		1									1		1								1	4	
23. Fresatrici speciali	3	7	3	1	4	4	3	3		3	3	3	1	2	1	3					2	46	
24. Altre fresatrici alesatrici verticali	1	2	1								3		1	1	1						1	11	622
25. Machining center verticali singoli	3	14					3	1				6				2					11	40	
26. Machining center verticali a torretta		25	1	1	5	14	4	4	1	3	2	4	10	4	3	2	1	1	3	10	10	108	
27. Machining center vert. aut. tool changer	9	16	11	6	5	8	8	3	4	8	13	5	5	7	12	7	12	13		10	2	164	
28. Machining center orizzontali singoli	2	5	1	3	1	2	4	6			3		1	1		2					6	37	
29. Machining center orizzontali a torretta		1									3											4	
30. Machining center orizz. aut. tool changer	8	30	25	11	21	18	10	21	15	14	16	4	11	13	7	31	7	8	7	14	7	298	651
31. Rettificatrici	4	9	5	1	1	4	3	4	5	6	6	10	3	4	3	7	2	2	5		7	91	
32. Varie puntatrici																							
33. Presse punzonatrici																							
34. Macchine per carpenteria	2			2		2	1	1	2		5		1	2	3	2						27	
35. Macchine per lamiera																							
36. Punzonatrici automatiche																							113
Totale	110	331	108	61	89	120	131	119	81	73	211	180	82	110	85	132	56	79	53	59	281	2554	

Table 3

Number of Imported MU/CN's Installed in Italy During 1985

[For Key to following numbered items, see Introduction preceding Table 1]

		Country of Origin								
		United States	Great Britain	Germany	France	Switzerland	Japan	Others	Totals by Item	Totals by Grpoup
1 Torni orizzontali a torretta		7	6	137	15	29	105	51	350	
2. Torni orizzontali automatic tool changer							3	2	5	
3. Torni verticali					2				2	
4. Altri							7	1	8	365
5. Alesatrici orizzontali a tavola							13	8	21	
6. Alesatrici orizzontali a montante				4		2	12	9	27	
7. Jig borer orizzontale										
8. Jig borer verticale							2	2	4	
9. Alesatrici tracciatrici						4			4	
10. Alesatrici da produzione								6	6	62
11. Foratrici singole				1		6			7	
12. Foratrici a torretta										
13. Foratrici verticali automatic tool changer				1				4	1	
14. Trapani radiali			9				3	3	15	
15. Altre foratrici alesatrici										23
16. Fresatrici verticali singole				9		8		7	24	
17. Fresatrici verticali a torretta				4				8	12	
18. Fresatrici orizzontali singole								14	14	
19. Fresatrici orizzontali a torretta										
20. Fresatrici per profili										
21. Fresatrici alesatrici				50				2	52	
22. Fresatrici tipo piallatrice				1					1	
23. Fresatrici speciali				4					7	
24. Altre fresatrici alesatrici verticali								3	3	113
25. Machining center verticali singoli		3	2			4		1	10	
26. Machining center verticali a torretta				3					3	
27. Machining center verticali automatic tool changer		10	2	4	5	2	25	2	50	
28. Machining center orizzontali singoli					3			2	5	
29. Machining center orizzontali a torretta										
30. Machining center orizzontali automatic tool changer		19	8	22	1	11	3	18	82	150
31. Rettificatrici			2	1		3		5	11	
32. Varie puntatrici		19	1		5	9			34	
33. Presse punzonatrici										
34. Macchine per carpenteria				4		2		1	7	
35. Macchine per lamiera			14	9			3	1	27	
36. Punzonatrici automatiche										79
Totale		58	44	254	31	80	176	149		792

Table 3 bis

Number of Imported MU/CN's Installed in Italy - Sold in 1985

Destination of MU/CN's - Type of Firm

[For Key to following numbered items, see Introduction preceding Table 1]	Aircraft & Motors	Automotive & Motors	Transportation except Automotive	Tractors	Construction & Agricultural Machinery	Machine Tools	Other Machines except Electrical	Electrical Machines and Plants	Communications	Instrumentation	Weapons/Arsenals	Dies	Schools	Woodworking Machines	Machines for Plastic Materials	Textile Machines	Compressors	Pumps	Carpentry	Metallic Furniture	Other	Totals by Item	Totals by Group
1. Torni orizzontali a torretta	16	68	21	12	15	21	17	6	14	6	31	20	5	11	13	21	11	9	6	3	24	350	
2. Torni orizz. automatic tool changer		1		2														1	1			5	
3. Torni verticali		2																				2	
4. Altri		3		1	1	2										1						8	365
5. Alesatrici orizzontali a tavola		4	2	4	1	1	5					2			1			1				21	
6. Alesatrici orizzontali a montante	2	6	2	3		6	1	1		1	1				1		1	1			1	27	
7. Jig borer orizzontale																							
8. Jig borer verticale	1	1			1							1										4	
9. Alesatrici tracciatrici		2	1																1			4	
10. Alesatrici da produzione		2								1				1					1		1	6	62
11. Foratrici singole	2	1							4													7	
12. Foratrici a torretta																							
13. Foratrici verticali automatic tool changer		1																				1	
14. Trapani radiali		5						4					3	2					1			15	
15. Altre foratrici alesatrici																							23
16. Fresatrici verticali singole		3	2	1	1	2					3			1	2	3			1	3	2	24	
17. Fresatrici verticali a torretta		2				1	1				1	1	3	1		1			1			12	
18. Fresatrici orizzontali singole		2		1	1	3	2		1			2					1				1	14	
19. Fresatrici orizzontali a torretta																							
20. Fresatrici per profili																							
21. Fresatrici alesatrici	3	10	2	6	1	5		7	2	1	3	2	2	2		2		2			2	52	
22. Fresatrici tipo piallatrice		1																				1	
23. Fresatrici speciali	1	2	1					1		1				1								7	
24. Altre fresatrici alesatrici verticali																1					2	3	113
25. Machining center verticali singoli		1			1				1		2			1				1	2		1	10	
26. Machining center verticali a torretta		2			1																	3	
27. Machining center vert. aut. tool changer	4	7		1			1	2	3	1	7	1	3	4	5	1	2			3	5	50	
28. Machining center orizzontali singoli										1	1	1	1						1			5	
29. Machining center orizzontali a torretta																							
30. Machining center orizz. aut. tool changer	11	12	5	4	5	5	4	2	4	1	4	12		2	3	1		1		1	5	82	150
31. Rettificatrici	1	3	1									2	1			1	1				1	11	
32. Varie puntatrici	6	3	2		4		1	3		5		3		2				3		1	1	34	
33. Presse punzonatrici																							
34. Macchine per carpenteria		1	1	1	1						2	1										7	
35. Macchine per lamiera	1	8	3		1						3					5			1	3	2	27	
36. Punzonatrici automatiche																							79
Totale	48	151	43	36	34	46	32	26	29	18	58	48	18	28	25	37	16	19	16	14	48	792	

Table 4

Type of MU/CN	MU/CN's Installed in Italy 1984	MU/CN's Installed in Italy 1985	Percent of MU/CN's 1984	Percent of MU/CN's 1985
Foratrici (1)	**59**	**88**	**3,2**	**3,9**
Fresatrici (2)	**365**	**520**	**20**	**22,9**
Torni (3)	**744**	**801**	**40,8**	**35,3**
Alesatrici (4)	**91**	**126**	**5**	**5,5**
Centri di lavorazione (5)	**442**	**601**	**24,3**	**26,5**
Altre (6)	**121**	**133**	**6,7**	**5,9**
TOTALE	**1822**	**2269**	**100**	**100**

Table 5

Type of MU/CN	MU/CN's Produced in Italy 1984	MU/CN's Produced in Italy 1985	Percent of MU/CN's 1984	Percent of MU/CN's 1985
Foratrici (1)	**98**	**138**	**4,7**	**5,4**
Fresatrici (2)	**488**	**622**	**23,3**	**24,3**
Torni (3)	**801**	**880**	**38,3**	**34,5**
Alesatrici (4)	**111**	**145**	**5,3**	**5,7**
Centri di lavorazione (5)	**509**	**651**	**24,4**	**25,5**
Altre (6)	**83**	**118**	**4**	**4,6**
TOTALE	**2090**	**2554**	**100**	**100**

Table 6

Type of MU/CN	Italian Machines Installed in Italy in 1985	Percent of Partial Total	Foreign Machines Installed in Italy in 1985	Percent of Partial Total	Partial Totals by Type of MU/CN
Foratrici (1)	**65**	**4,4**	**23**	**2,9**	**88**
Fresatrici (2)	**407**	**27,6**	**113**	**14,3**	**520**
Torni (3)	**436**	**29,5**	**365**	**46,1**	**801**
Alesatrici (4)	**64**	**4,3**	**62**	**7,8**	**126**
Centri di lavorazione (5)	**451**	**30,5**	**150**	**18,9**	**601**
Altre (6)	**54**	**3,7**	**79**	**10**	**133**
Totali parziali e generale (7)	**1477**	**100**	**792**	**100**	**2269**

Key:

1. Drilling machines.
2. Milling machines.
3. Lathes.
4. Boring Machines.
5. Machining centers.
6. Other.
7. Partial and general totals.

Table 7

Orders for Italian MU/CN's in 1985
(in Numbers)

[For Key to following numbered items, see Introduction preceding Table 1]	Italy	United States	Great Britain	Germany	France	E. European Countries	Rest of E. Europe	Asia	Americas excl. United States	Other	Totals by Item	Totals by Group
	Destination											
1. Torni orizzontali a torretta	371	14	19	18	26	5	34	2	13	3	505	
2. Torni orizzontali automatic tool changer	1										1	
3. Torni verticali	60	30	9	40	20	5	25		2		191	
4. Altri	16		2	5	3	1	8		1	10	46	743
5. Alesatrici orizzontali a tavola	35		3	11	3	5	2			1	60	
6. Alesatrici orizzontali a montante	21				3		2		1	1	28	
7. Jig borer orizzontale												
8. Jig borer verticale												
9. Alesatrici tracciatrici	10		8			8					26	
10. Alesatrici da produzione												114
11. Foratrici singole	5										5	
12. Foratrici a torretta	22			10	4		4				40	
13. Foratrici verticali automatic tool changer	9		1	5	6		4				25	
14. Trapani radiali	10			8		9	7				34	
15. Altre foratrici alesatrici		1									1	105
16. Fresatrici verticali singole	114			19	14	3	24	2	4	8	188	
17. Fresatrici verticali a torretta	2		11				1				14	
18. Fresatrici orizzontali singole	107		4	19	1		12			4	147	
19. Fresatrici orizzontali a torretta	18										18	
20. Fresatrici per profili	13	3							6		22	
21. Fresatrici alesatrici	130	3	10	30	7	8	31	2		3	224	
22. Fresatrici tipo piallatrice	2								6		2	
23. Fresatrici speciali	24	2		13	13						58	
24. Altre fresatrici alesatrici verticali	8					2	1				11	684
25. Machining center verticali singoli	10	11		3		1					25	
26. Machining center verticali a torretta	43			6	7	3	4				63	
27. Machining center verticali automatic tool changer	147		9	4	37	11	2				210	
28. Machining center orizzontali singoli	27	3				3					33	
29. Machining center orizzontali a torretta												
30. Machining center orizzontali automatic tool changer	175	3	10	22	51	11	1	1	3		308	638
31. Rettificatrici	26	2	2			6			1		37	
32. Varie puntatrici												
33. Presse punzonatrici												
34. Macchine per carpenteria	17		6								23	
35. Macchine per lamiera												
36. Punzonatrici automatiche												60
Totale												
Totale generale	1423	72	94	213	195	81	182	18	37	30	2345	

Machines w/positioner excluded from this survey

* atc = automatic tool changer

Table 8

Orders for Foreign MU/CN's in 1985
(in Numbers)

[For Key to following numbered items, see Introduction preceding Table 1]		Italy	United States	Great Britain	Germany	France	E. European Countries	Rest of E. Europe	Asia	Americas excl. United States	Other	Totals by Item	Totals by Group
		Origin											
1. Torni orizzontali a torretta			7	3	90	10	46	11	53		6	226	
2. Torni orizzontali automatic tool changer							1		7			8	
3. Torni verticali						1						1	
4. Altri					4				9			13	248
5. Alesatrici orizzontali a tavola							12					12	
6. Alesatrici orizzontali a montante							19				4	23	
7. Jig borer orizzontale													
8. Jig borer verticale							1		2			3	
9. Alesatrici tracciatrici								4				4	
10. Alesatrici da produzione							7					7	49
11. Foratrici singole													
12. Foratrici a torretta													
13. Foratrici verticali automatic tool changer					1							1	
14. Trapani radiali							13					13	
15. Altre foratrici alesatrici													14
16. Fresatrici verticali singole					12		3	5			2	22	
17. Fresatrici verticali a torretta					3			10				13	
18. Fresatrici orizzontali singole							3					3	
19. Fresatrici orizzontali a torretta							3					3	
20. Fresatrici per profili													
21. Fresatrici alesatrici				39	8		1					48	
22. Fresatrici tipo piallatrice					1		1					2	
23. Fresatrici speciali					2		1					3	
24. Altre fresatrici alesatrici verticali													94
25. Machining center verticali singoli				6	1		1					8	
26. Machining center verticali a torretta					3							3	
27. Machining center verticali automatic tool changer			3	6	3			4	4			24	
28. Machining center orizzontali singoli					5		1					6	
29. Machining center orizzontali a torretta													
30. Machining center orizzontali automatic tool changer			18	2	9	1	13	9	3		4	59	100
31. Rettificatrici			11		5	3	4				4	27	
32. Varie puntatrici			4	9								13	
33. Presse punzonatrici													
34. Macchine per carpenteria				3	2							5	
35. Macchine per lamiera			12		1							13	
36. Punzonatrici automatiche					34							34	92
Totale													
Totale generale			55	68	184	15	130	43	78		24	597	

Machines w/positioner excluded from this survey

Table 9

MU/CN Installations in Italy

Year	Perforating Machines		Milling Machines		Lathes		Boring Machines		Machining Centers		Other		Yearly Totals	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
To 1969	60	12,8	96	20,5	36	7,7	97	20,7	142	30,4	37	7,9	468	100
1970	29	7,6	90	23,8	49	12,9	55	14,5	144	37,8	13	3,4	380	100
1971	17	5,1	108	32,2	38	11,4	36	10,7	110	32,8	26	7,8	335	100
1972	20	5,3	125	33,2	57	15,1	58	15,1	84	22,3	33	8,7	377	100
1973	22	4,5	114	23,4	185	38,1	39	8,3	85	17,5	40	8,2	485	100
1974	22	3,9	104	18,5	256	45,6	45	8	105	18,7	30	5,3	562	100
1975	29	4,2	150	22	310	45,4	52	7,6	102	14,9	40	5,9	683	100
1976	38	5,7	107	16	334	49,5	54	8,1	94	14	45	6,7	672	100
1977	38	4,7	143	17,5	447	54,6	43	5,2	110	13,5	37	4,5	818	100
1978	52	4,7	168	15,2	580	52,3	70	6,3	190	17,1	49	4,4	1109	100
1979	56	3,5	199	12,5	925	58	98	6,1	264	16,6	53	3,3	1595	100
1980	84	4,1	232	11,4	1271	62,3	98	4,8	289	14,2	65	3,2	2039	100
1981	72	3,8	213	11,1	1113	58,3	85	4,4	354	18,6	72	3,8	1909	100
1982	56	3,7	185	12,4	769	51,5	75	5	334	22,4	74	5	1493	100
1983	48	3,7	218	16,6	585	44,5	60	4,5	321	24,4	83	6,3	1315	100
1984	59	3,2	365	20	744	40,8	91	5	442	24,3	121	6,7	1822	100
1985	88	3,9	520	22,9	801	35,3	126	5,5	601	26,5	133	5,9	2269	100
Totals by type of MU/CN	790	4,3	3137	17,1	8500	46,4	1182	6,4	3771	20,6	951	5,2	18331	100

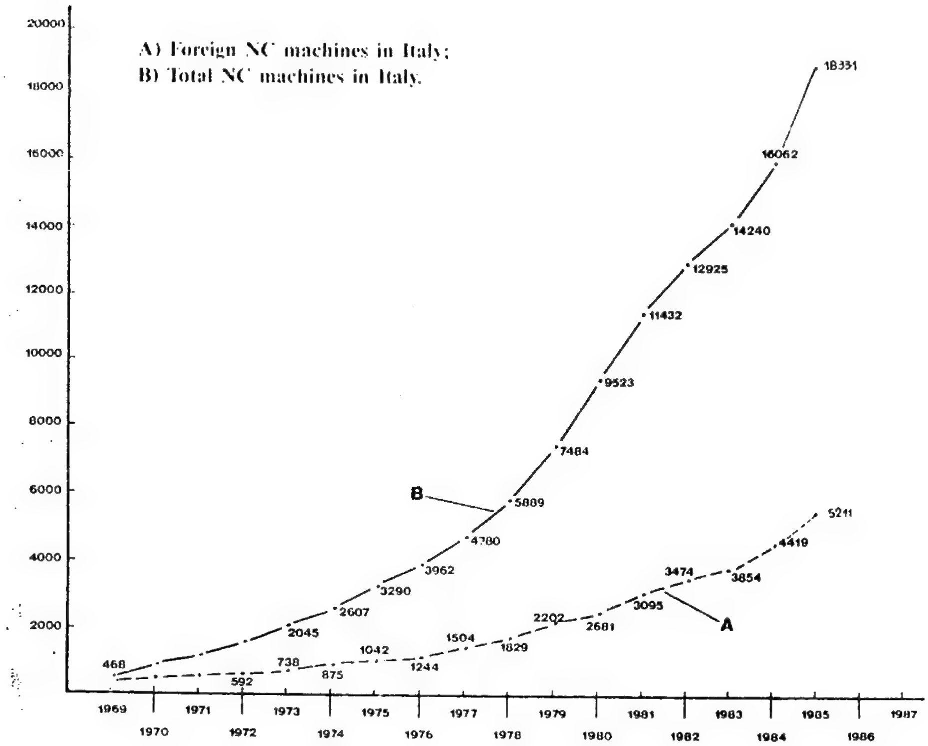
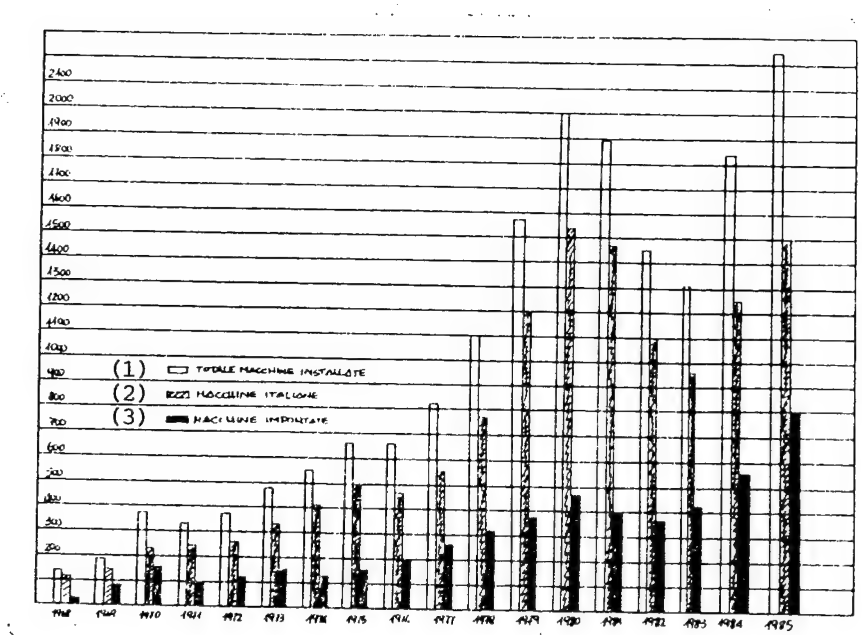


Fig 1 - MU/CN Installations in Italy.



Key:

1. Total number of NC machine tools (white).
2. Italian-manufactured machines (hatched).
3. Imported machines (black).

Fig 2 - Annual MU/CN installations in Italy.

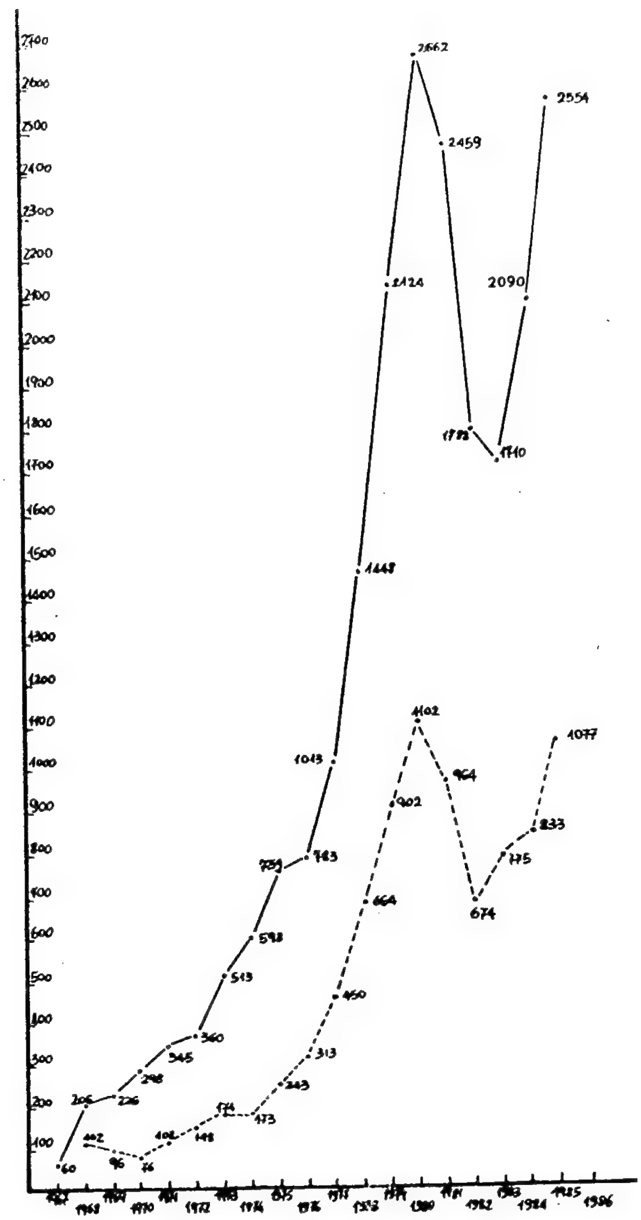


Fig 3 - Annual Italian production of MU/CN's. The figure for 1967 represents a reliable estimate; those for succeeding years are taken from annual copyrighted survey findings by TECNICHE NUOVE. Dashed line represents exports.

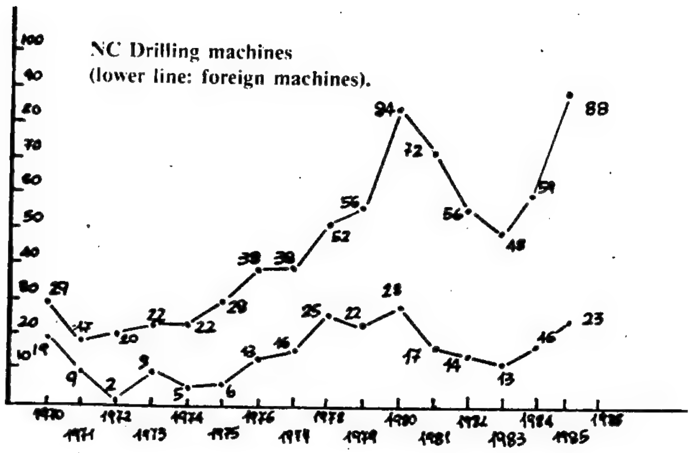


Fig 4 - Annual NC drilling machine installations in Italy.

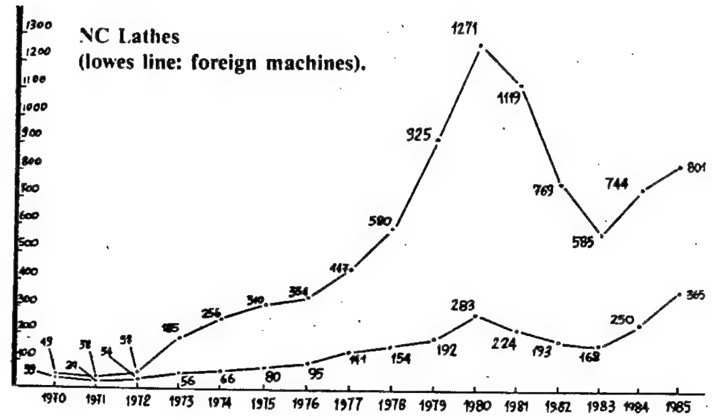


Fig 6 - Annual NC lathe installations in Italy.

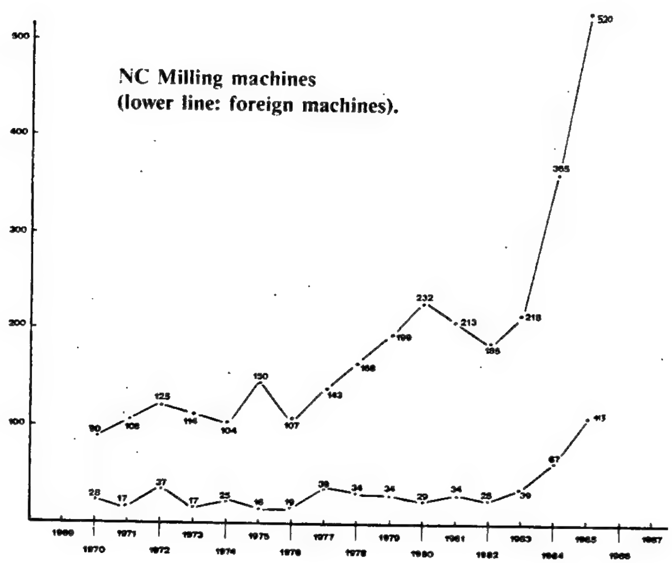


Fig 5 - Annual NC milling machine installations in Italy.

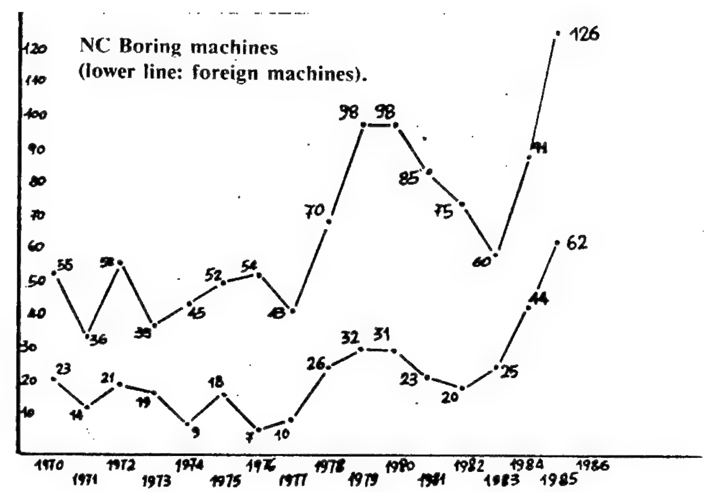


Fig 7 - Annual NC boring machine installations in Italy.

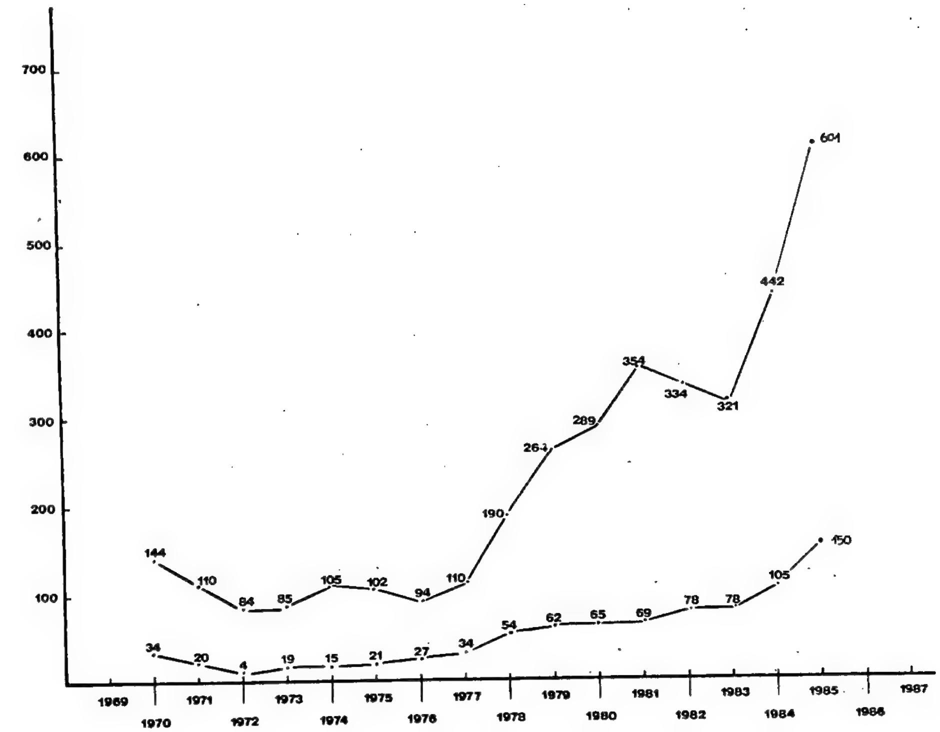


Fig 8 - Annual machining center installations in Italy.
Lower line: Machines of foreign manufacture.

9399

PROSPECTS FOR FIBER OPTICS IN EUROPE DISCUSSED

Milan INGEGNERIA in Italian May-Jun 86 pp 156-157

[Article: "Optical Fiber Sensors in Europe"]

[Text] European industry will be using a greater number of optical fiber sensors over the next 4 years. The main reason is the growing need for sensors to improve performance in sophisticated systems--and measurement systems based on light are among the most accurate currently available.

Frost & Sullivan sees a flourishing market looming for optical fiber sensors, which transmit light through tiny glass or plastic cores cladded with special materials, for diverse applications.

The recent expansion in the use of optical fibers in telecommunications has already familiarized European industry with such products and has at the same time contributed to a lowering of prices of components. These developments have opened the way for optical fiber sensors. A new study by Frost & Sullivan, "Optical Fiber Sensors in Europe" (E799), projects a sizable growth in all the principal markets, between 1986 and 1990, as optical fibers gradually emerge from the research phase and find new applications. The market will attain a global figure of $85.9 million by 1990 relative to the 1984 figure of $4.2 million (at constant prices).

The 345-page study addresses in detail the principal components of this applications market and the advantages of optical fiber sensors. It cites electrical insulation among these advantages, in that, optical fiber sensors are electrically passive, which renders them particularly suited for use in high-voltage and medical applications. They are also chemically inert, a useful characteristic for applications involving high temperatures or corrosive conditions. Their extremely small dimensions, light weight, and low inertia are further advantages of optical fiber sensors.

In the future, other factors, such as their simplified interfaceability with data transmission systems based on optical fibers, will become even more important. Furthermore, the use of optics for signal processing can be introduced, involving the production of "intelligent" passive sensors without electricity.

Frost & Sullivan affirms that "opportunities are evident both for the manufacturers of specialized components such as fibers and couplers and as regards instruments and complete systems. These opportunities are valid for the small-sized firms as well as the large. Some highly diversified large firms are working on optical fiber sensors and related components, in many cases as an integral part of programs for developing sensors on a very broad scale...

"Small-sized firms tend to be more specialized, limiting their activity to more specific applications. Many of these are newly-formed enterprises that have come over from the United States." The study lists the firms that already manufacture components for optical fiber sensors, in Europe, as well as the United States, Japan and Canada.

The study provides a detailed analysis of the size of the European market, and near-term forecasts for all user sectors--from the energy and public services sectors to the medical and military-aerospace sectors.

Presently, the dominant market is the military-aerospace one ($5.2 million in 1985), but Frost & Sullivan foresees a rather fast growth (in the medical field (at an annual rate of over 300 percent) over the next 2 years. The development of a good consumer market is foreseen for 1988, mostly in optical fiber sensors for automobiles and household appliances.

The price of the study is $2,250.

9399
CSO: 3698/268

DORNIER REPORTS ON X-SAR RADAR DEFINITION, DEVELOPMENT PHASES

Friedrichshafen DORNIER POST in English No 3, Mar 86 pp 46-68

[Article by Wolfgang Gilg and David Miller: "Synthetic Aperture Radar X-SAR in Joint Missions;" first paragraph is DORNIER POST introduction]

[Text] The definition phase of X-SAR is finalized and the development phase will start end of 1986. This is a logical continuation of Dornier's activities in spaceborne microwave sensor development and represents a challenge to industry in terms of technological advancements. The definition studies were performed on behalf of the German and Italian Ministries of Research and Technology. The X-SAR will fly on Space Shuttle in joint missions with NASA's Spaceborne Imaging Radar (SIR-C), providing the first multispectral/dual-polarized spaceborne SAR experiment. Hence, the X-SAR will provide important new mesurement data for scientists.

Images of the Earth's surface can be produced by a spaceborne sensor via transmission and reception of radio waves. The method relies on the characteristic that different surface features (e.g. cities, cornfields) reflect radio waves by different amounts. It is comparable to the differing reflectivity of surfaces to sunlight. A radar sensor has the advantage that measurements can be performed independently of cloud cover and time of day. A radar image is a map of the Earth's surface in which image intensity (e.g. grey level) represents scene reflectivity. An important image quality criterion is the spatial resolution, i.e. how well a particular target (e.g. a building) can be separated from its neighbors. Good spatial resolution is achievable when the radio waves illuminate the scene in small parts. The area illuminated by rdio waves is constrained by the width of the transmitted beam of radiation.

When a radar sensor flies past a pair of targets, separation in the image is possible when the radar beam width is less than the distance between the targets. Fine resolution requires narrower beamwidth, hence a larger antenna size which soon becomes impractical for space use. The principle of Synthetic Aperture Radar (SAR) allows a small moving antenna to achieve fine resolution in the along track direction via elaborate processing. In the case of X-SAR, the required along track resolution would require a physical antenna length of over 300 m compared to the actual 12 m version.

The X-SAR is a synthetic aperture radar working in X-band to be flown together with NASA's Spaceborne Imaging Radar, itself allowing measurements in L-and C-band. The first flight is scheduled for [the beginning of] 1990,

and the second flight six months later. This is scientific interest for measurements at different seasons. Of particular interest is the instrument capability for simultaneous Earth observation at three radar frequencies 1.3 GHz, 5.3 GHz (SIR-C), and 9.6 GHz (X-SAR), together with dual polarization for SIR-C. The baseline mission of six days duration implies 48 hours SAR data for each of five channels.

Each radar will use planar antenna arrays, 12 m in length, mounted on a common supporting structure which is rotatable over a wide angular range, enabling measurements over a large range of incidence angle on ground.

For the nominal orbit altitude of 255 km, X-SAR will provide a resolution better than 30 m in range and azimuth, and a swatch width greater than 15 km.

In order to adapt the instrument to the different geometrical conditions, several parameters are selectable from ground: pulse repetition frequency, position and length of the echo window, echo quantization bit number, and the transmit pulse chirp bandwidth.

System Overview

The two major parts of X-SAR are the onboard sensor and the processing and control sections on ground. For handling the X-SAR data, recording and transmission serivces will be provided by SIR-C and [the] Shuttle. Normally, X-SAR will operate synchronously with SIR-C, however, X-SAR can also operate in an autonomous mode.

During the synchronous operation X-SAR operates as a slave and is triggered by PRF-pulses provided by SIR-C (PRF means the repetition frequency of the transmitted radar pulses). Autonomous Operation is characterized by the internal timing of X-SAR.

The system provides simultaneously five SAR data channels each producing 45 Mbps SAR raw data of the same target area. All data will be stored on board, and one channel can be selected for real time transmission via the Tracking & Data Relay Satellite System (TDRSS). After reception on ground, X-SAR data will be processed in real time by the X-SAR survey processor. In order to achieve comparable SAR measurements of SIR-C and X-SAR, many requirements for the instrument design are the same for both sensors, particularly for geometry and timing parameters.

Mechanical Configuration

The electronics boxes are mounted on the pallet which is shown in view looking from nose to aft of the Shuttle. The pallet itself is mounted below the middle part of the foldable antenna into the cargo bay. The X-band antenna (12 m in length and 0.4 m in width) will be mounted close to the tilt axis of the common antenna support structure. Connection to the transmitter/receiver is via a flexible waveguide and a rotary joint coaxial with the tilt axis.

Electrical Configuration

The electrical block diagram of the on-board sensor contains the main functionl blocks of each of the four subsystems, namely the Data & Control Electronics (DCE), the Radio Frequency Electronics (RFE), the High Power Amplifier (HPA), and the Antenna.

The principle performance parameters for X-SAR are resolution (spatial and radiometric), integrated sidelobe ratio (SLR) and ambiguity level. The performance aims apply to the circular orbit of 255 km nominal altitude with ± 0.5 degrees altitude uncertainty in each axis and an altitude uncertainty of ± 1.5 km.

Performance constraints are the 45 Mbps maximum data rate and the 1234-1803 Hz PRF range. At large off-nadir angles, the data rate limits the swath width, whereas, at small off-nadir angles, it is limited by the elevation beam width.

Predicted Performance

Spatial resolution in range direction for each of the RF bandwidths is off-nadir angle (Nadir is the point on the Earth directly beneath the Shuttle). For azimuth resolution, current analysis indicates a resolution of about 33 m for the 250 Hz look bandwidth.

Radiometric resolution is a measure of the ability of the system to discriminate between distributed target reflectivity levels. It is limited by the inherent echo statistics, and practically constrained by the processed look number and signal-to-noise ratio (SNR). At 60 degrees off-nadir angle, it is necessary to operate the radar with a lower PRF and integrate a reduced number of radar echoes (fewer looks) to achieve clear images. The performance swath width is that region within the data collection swath over which the performance aspects satisfy their aims.

Conclusions

The X-SAR/SIR-C mission represents the first multispectral/dual-polarized spaceborne SAR experiment. It will provide a large amount of useful and unique SAR imagery and help to derive and understand future user requirements.

Ongoing performance analysis incorporates the effects of instrument phase and amplitude errors and the quality of the SAR processing algorithms. It will ensure a balanced system design compatible with the performance aims, hence guaranteeing collection of useful image data.

The mission provides a basis for future operational SAR systems, enabling the optimization of geometry, frequency and polarization.

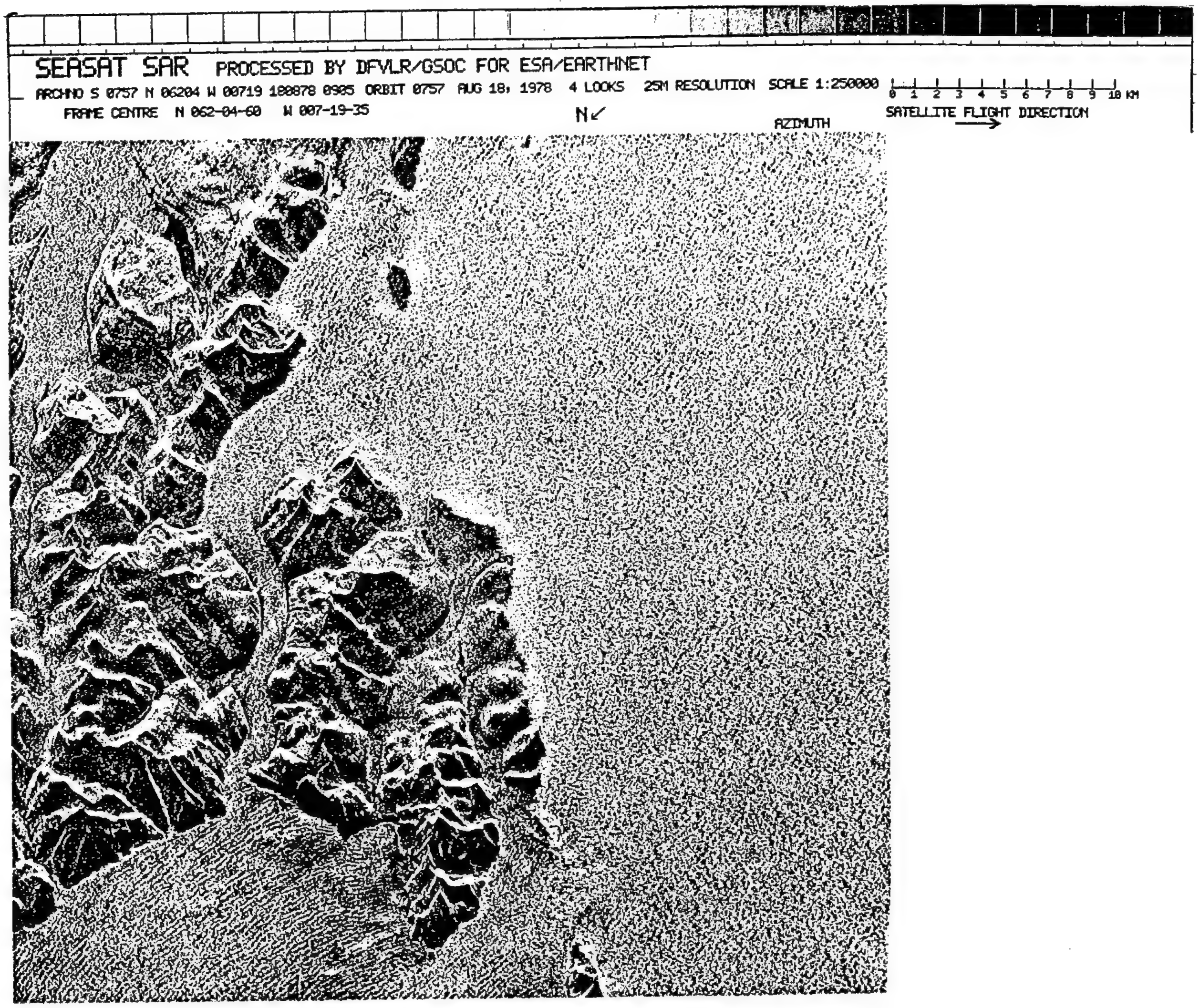


Fig. 1. SEASAT SAR image of islands north of Scotland

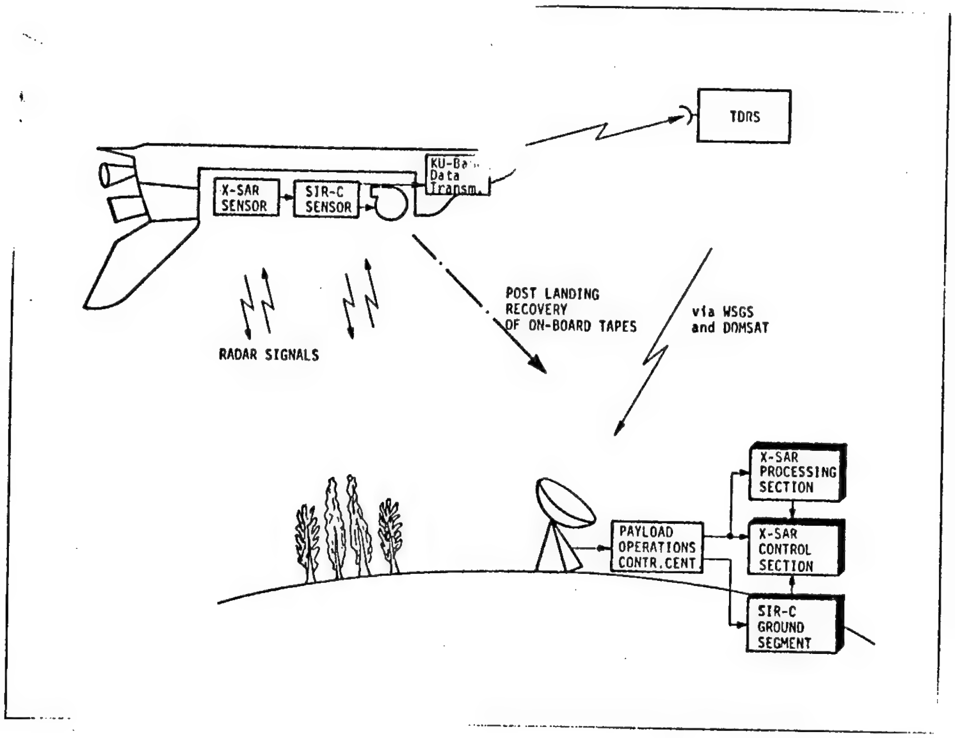


Fig. 2. X-SAR/SIR-C system overview

Altitude	255 km
Orbit Inclination	> 57°
Frequency	9.6 Ghz
Polarization	Vertical (VV)
Peak Power	3 KW } HPA
Average Power	220 W } OUTPUT
RF-Bandwith	9.5/19 MHz
Off-Nadir Angle	15–60°
Swath Width	≥ 15 km
Spatial Resolution	
Range (across track)	≤ 30 m
Azimuth (along track)	≤ 30 m

Fig. 3. X-SAR instrument requirements

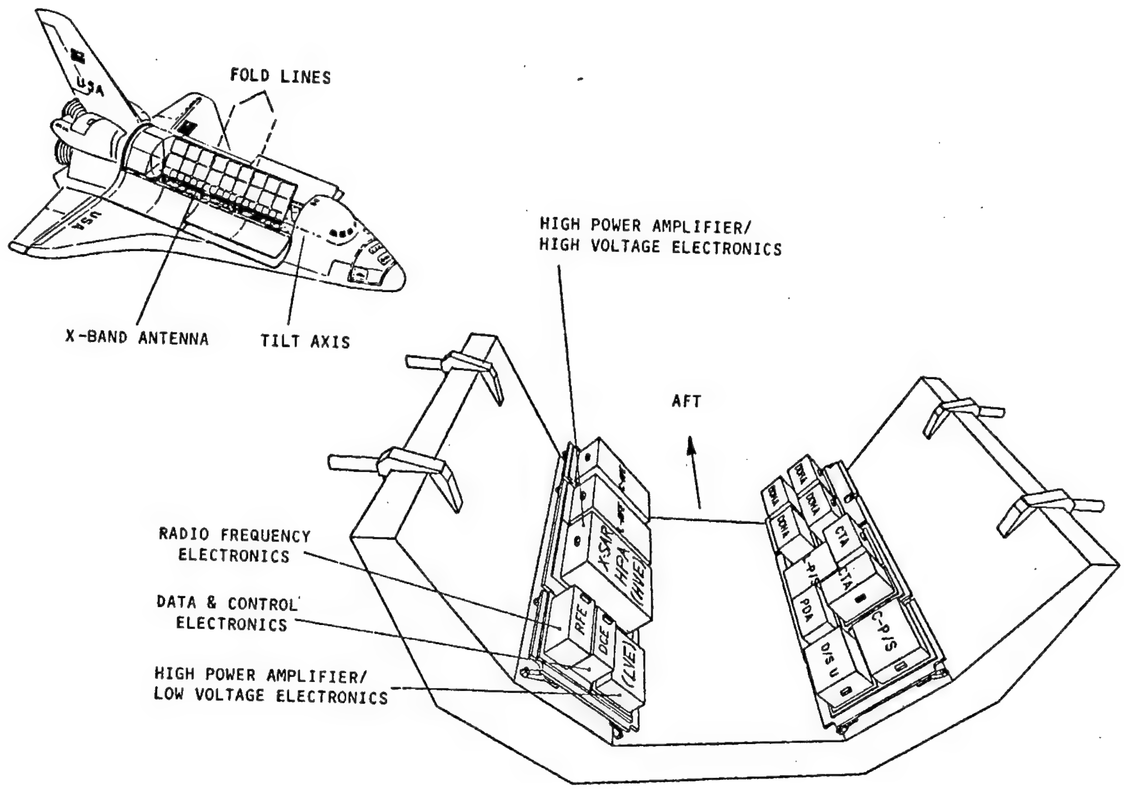


Fig. 4. Mechanical configuration

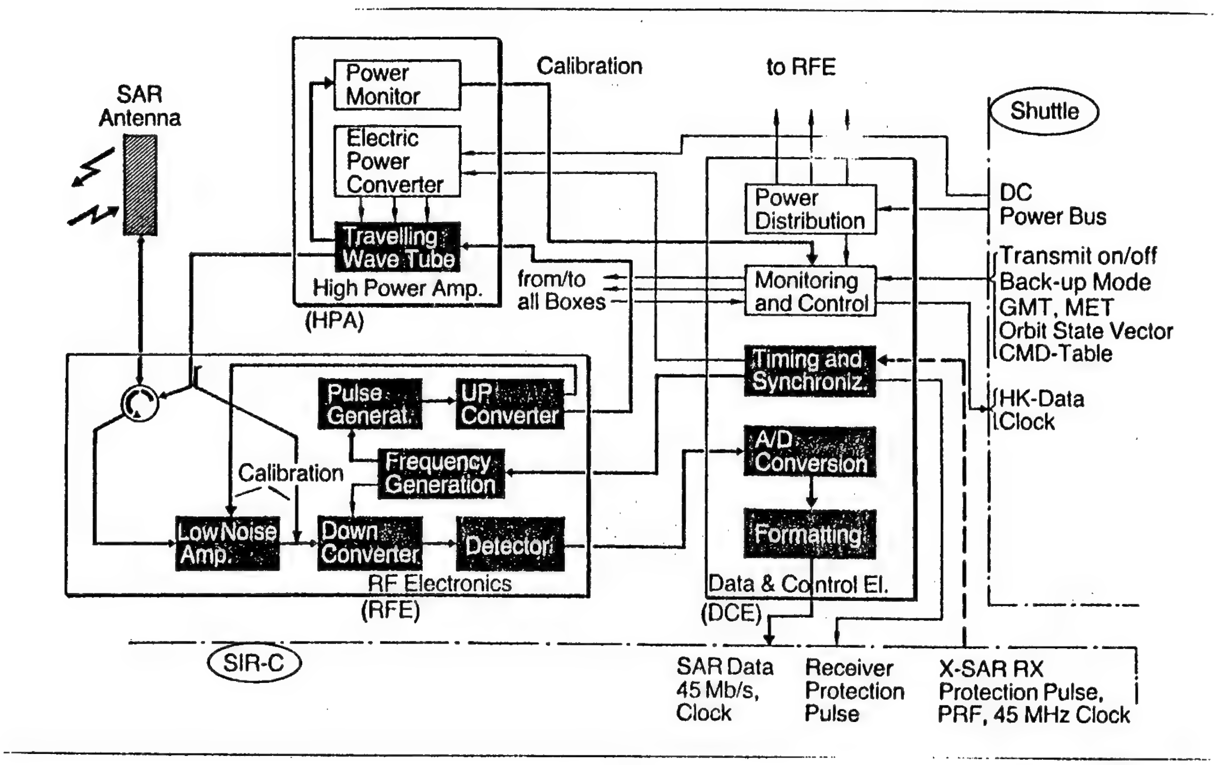


Fig. 5. Electrical configuration

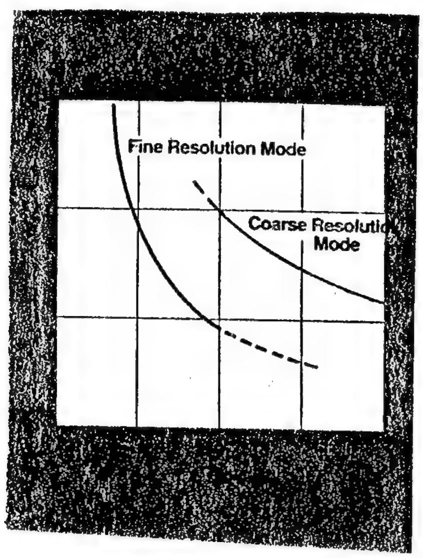


Fig. 6. Range resolution (across track)

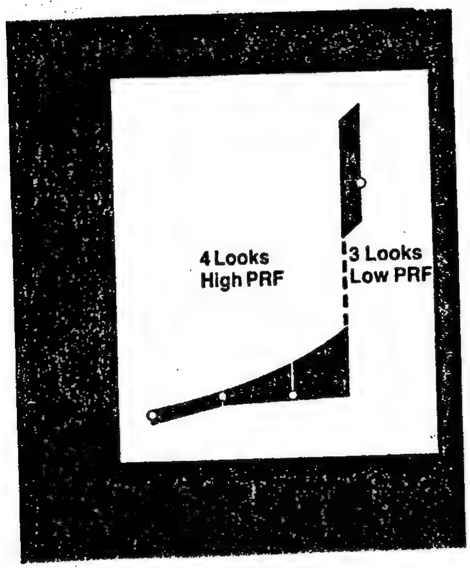


Fig. 7. Radiometric resolution (γ'min=-18dB)

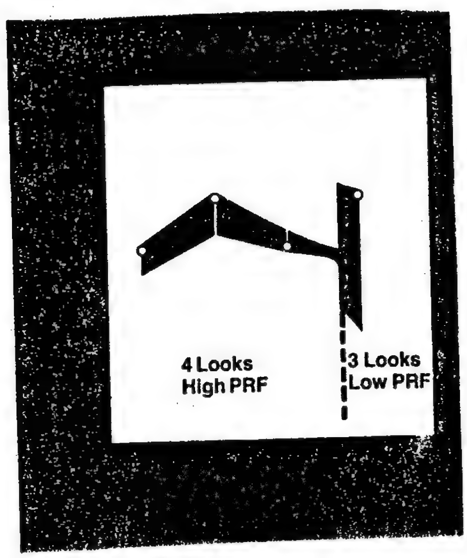


Fig. 8. Swath width

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ELECTRONICS R&D IN FRANCE'S 'SILICON VALLEY': GRENOBLE

Electronics Sector Development

Le Chesnay BULLETIN DE LIAISON DE LA RECHERCHE EN INFORMATIQUE ET AUTOMATIQUE in French Jun-Jul 86 pp 2-6

[Article by M. Cordelle, CEA [Atomic Energy Commission] (CENG [Grenoble Nuclear Studies Center]--17, av. des Martyrs; BP 85X; 38041 Grenoble Cedex): "Development of the Electronics Sector at Grenoble"]

[Text] The Grenoble region, which has traditionally focused on high tech industries, has seen its calling to the electronics sector confirmed over the last 20 years. In late 1982 a government report on the subject made the following comments, identifying the Grenoble region's present make-up as:

- 0.9 percent of the total French population,
- 1 percent of the working population,
- 1.1 percent of all industrial jobs in France,
- 3 percent of all industrial jobs in the electronics sector, accounting for:
    - 4.7 percent of total data processing sales,
    - 7 percent of electronic components sales,
    - 14 percent of semiconductor sales,
    - 30 percent of integrated circuit sales
    - 30 percent of minicomputer sales,
- 10 percent of all research jobs in the electronics sector,
- 14 percent of new graduates from engineering schools,
- 5 percent of new graduates from the advanced technical schools: DUT [University of Technology Graduate] and BTS [Advanced Technical Certificate].

The Grenoble region alone boasts one-third of the jobs and 40 percent of the industrial work force (9,000 people) of the electronics industry in the Rhone-Alps region. Such a concentration in one geographical area is found nowhere else in France.

This Grenoble activity involves active exchange with other industrial sites in the region: the greater Lyon area, Saint-Etienne, Valence. Such ties are also found all along the French Alps, in Grenoble, Chambery, Aix-les-Bains,

Annecy, and Annemasse, where small- and medium-sized electronics companies are currently developing.

Relationships between these companies and the Grenoble research centers, complementary activities (such as that begun between Grenoble and Saint-Etienne in the area of robotics), subcontracting among hardware manufacturers, industrially innovative companies, and complementary firms (precision mechanics, plastic molding, assembly, etc.) must still be developed within the region.

Indeed, electronics companies cannot continue to grow in the absence of a diversified and complementary environment. It is well known that companies prefer to work with subcontractors located within a radius of 150 to 200 kilometers around the contracting company.

The government's ambitious objectives require considerable effort in the areas of research, investment, and productivity, along with better synergy between various sectors.

Undeniable Advantages

Grenoble's electronics industry enjoys a unique position in the Rhone-Alps region: It appears to be the regional hub of electronics from which it is possible to spread out to the other zones of activity in the Rhone-Alps or other regions. There are concrete examples of this: Merlin-Gerin has built facilities at Montmelian, Ales, and Privas, while Cap Gemini Sogeti has them throughout France.

The Grenoble region offers the heaviest concentration of electronics companies, schools, and laboratories anywhere in France, outside of Paris.

Schools and a University with Strong Reputations

There are 500 engineers and MS graduates trained each year in electronics and data processing, as well as 300 BTS-DUT technicians, for a total of some 800 new graduates per year.

An Impressive Range of Researchers

There are 3,200 electronics researchers from a total of more than 10,000 in the metropolitan area. Of these, 1,540 work in private companies, 920 in state laboratories, and 740 in the university and the CNRS [National Center for Scientific Research].

Increasingly Diversified Industry

Twelve years ago, Grenoble's electronics activities were overwhelmingly dominated by components manufacturing, but it has managed to diversify thanks to the conversion of Merlin Gerin, the arrival of Hewlett-Packard, and the creation of the companies in the ZIRST in Meylan (the 34-hectare Industrial Zone for Scientific and Technical Research with 70 companies and 2,600 employees).

However, consumer electronics, the telephone industries, and high volume, labor-intensive manufacturing are rare or nonexistent in Grenoble.

Grenoble's electronics industry currently provides four major types of activity:

1. Components: various Thomson divisions (EFCIS, DCI, DMS, DTE), Radiall;

2. Computers: Hewlett-Packard, Bull-Sems;

3. Microelectronics: for use in automation, microcomputers, systems, and data communications: Merlin-Gerin, Jay, Cometa, and many newer small- and medium-sized companies, mostly established in the ZIRST within the last 10 years, such as AET, AID, APSIS, GEA, SOPRA, SYSECA, TELEMATIQUE, XTEL, to mention only the largest.

4. Data Processing services: Cap Gemini Sogeti, 3I, CISI, ITMI.

First of all, let us note that everything is in a state of flux; we are far from stabilization; training and research continue to develop:

Within the university and CNRS

- increased number of engineers trained at INPG [National Polytechnic Institute of Grenoble], creation of new study options: CAD in electrical engineering, mechanical electronics, large electronic systems.

- establishment of programs aimed at doubling the number of research-trained engineers.

FIRTECH now offered:

-AI, data processing, and communications

FIRTECH now in preparation:

- electronics
- factory automation

- creation of the Institute of the Intelligent Machines at the INPG, bringing together 200 researchers from various organizations.

-creation of a University Factory Automation Workshop.

Within CNET [National Center for Telecommunications Studies]

The 1983-1986 operational directives for the Norbert Segard Center, which has been in operation for several years, confirmed its objective of developing micron-level CMOS technology specifically for telecommunications.

A second block of investments should allow it to increase its research effort in fields not yet sufficiently covered, specifically in technology modeling, design and testing of integrated circuits at all levels of integration, and manufacturing support techniques.

Within the Institute of Technological Research and Development of the CEA

LETI [Laboratory for Electronic and Data Processing Technology] is increasing its activities in several fields:

- microelectronics
- magnetic recording

At the same time it is strengthening ties with its manufacturing partners: Thomson-CSF for microelectronics, Rhone-Poulenc for materials, SAGEM [Company for General Electricity and Mechanics Applications] for magnetic storage, Thomson-CSF and SAT [Telecommunications Corporation] for infrared technology, Intertechnique for data processing.

Following construction of a new microelectronics building, dedicated early this year by the president of France, staff has been increased to 610.

Various new forms of collaboration have been implemented with manufacturing firms to improve the efficiency of technology transfer and to reduce costs.

Finally, new investments are scheduled which will prepare it to take advantage of the current receptivity of the European market.

In industrial development

While less flashy, there are nevertheless encouraging signs that, here too, things are moving.

The 1982 government report on the electronics sector in the Grenoble region concluded:

"Industry, research, and training constitute a unique combination of assets which strengthens the position of the Grenoble electronics center in its complementary relationships with the Rhone-Alps region.

"For either the nation's success in developing its electronics sector or France's potential role in European cooperation, our region has many valuable assets. These assets have developed thanks to its dynamism, but also because the nation has made a major effort here to support the electronics sector.

"Everything is in place (or almost) at Grenoble for the multiple interactions between training, research, and industry (interactions responsible for the stunning success of certain major foreign electronics centers) to become fully effective.

"It would be inconceivable not to use these assets for the benefit of the nation in a field where rapid growth is a condition for survival on the international level."

Today we can say that our region certainly managed to take advantage of its opportunities in the fields of training and research. It now needs to consolidate its industrial activities through the installation of units of major national or multinational groups and through the successful transformation of several of the brilliant efforts of young entrepreneurs.

Data Processing Research

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[Article by G. Veillon, ENSIMAG [National Advanced School for Data Processing and Applied Mathematics at Grenoble] (Domaine Universitaire, BP 46, Saint Martin d'Heres): "Research in Data Processing and Applied Mathematics at Grenoble"]

[Text] Data processing research at Grenoble is particularly marked by the influence of manufacturing and by its large proportion of contract activities: Contracts represent more than 60 percent of the laboratories' resources. This influence of manufacturing translates into a good rapport with the region and a rather strong orientation toward implementation, particularly through creation of new companies.

Another characteristic of this research is the very rapid turnover (more than 15 percent) in researchers. This turnover is related both to the large number of non-permanent researchers (those on scholarships, grants, and contracts) and to the many possibilities for recruitment provided by the integration of research and training, primarily involving graduating 3d-cycle DEA [Advanced Study Diploma] and 2d-cycle DESS [Specialist Studies Diploma] students and engineering student completing their studies (most final projects are carried out in laboratories). This turnover also extends to research management staff, with notably the successive departures of Michel Sakarovitch (Bull), Francois Anceau (Bull), and Jean-Claude Latombe (ITMI), replaced by J. Crowley (CMU). Recruiting and keeping management is one of the laboratories' major problems.

International relations have recently developed in the form of several European projects (CASCADE, CVT, several ESPRIT projects, STIMULATION, and CREST).

Organizational Structure

Data processing and applied mathematics research at Grenoble is essentially associated with two university institutions:

- the National Polytechnic Institute [INPG] and
- the Scientific and Medical University [USMG].

The university's laboratories belong to the data processing and applied mathematics training and research unit, while the laboratories linked to the INPG are those of the National Advanced School for Data Processing and Applied Mathematics at Grenoble [ENSIMAG]. The link with structures having the dual roles of training and research leads to strong interaction between these two activities. Students are attracted to the laboratories by the 3d DEA and doctoral training associated with them and by the university's ENSIMAG and DESS programs; they thus provide a recruiting base for trainees and young researchers.

The Applied Mathematics Service created by J. Kuntzmann in 1960, which later became the Grenoble Data Processing and Applied Mathematics (IMAG) laboratory, was recently reorganized into six laboratories.

This reorganization, necessary due to the size of the IMAG laboratory (more than 400 people), threatened to weaken the Grenoble community. The creation of the IMAG Institute and the significant participation of most researchers in the joint teaching activities made it possible to maintain structures for collaboration and coordination.

IMAG is a cooperative structure which manages a number of facilities shared by all the laboratories: the media library and electronic, software, and reprographic services. IMAG is headed by P.J. Laurent and is a service unit of the CNRS [National Center for Scientific Research].

The laboratories which evolved from IMAG were based on existing teams. One of the positive aspects of this reorganization was that it created multidisciplinary groups and encouraged association between theoreticians and applied scientists. The close contact of disciplines within IMAG, particularly between applied mathematics and data processing (TIM3 [Data Processing, Mathematics, Microelectronics, and Quantitative Microscopy Technologies] and ARTEMIS [Research Workshop for Systems Mathematical and Data Processing Techniques] laboratories), led to possibilities for new collaboration with disciplines and laboratories from outside IMAG: contacts with medicine and biological and medical engineering at the university (TIM3 laboratory), and with electronic and automation engineers at INPG.

The laboratories are located at two sites in greater Grenoble: the university campus and the INPG facilities in central Grenoble. They share major assets:

- the services of IMAG, especially the computer facilities (VAX 780, the ETHERNET network linking all the laboratories),

- the CMP service (multiproject circuits) of the architecture team (TIM3),

- the shared interuniversity services: Microelectronics Center (VAX 780 for design), access to the Grenoble Computing Center (DPS-8 MULTICS).

Research Topics and the Laboratories

The list of the laboratories' research activities includes several major recurring topics: systems and machine architecture, parallelism, programming,

and AI. These topics are handled through different approaches and applications in virtually all the laboratories. This complementary nature has given rise to cooperation on joint projects: CVT project, LUSTRE (real-time programming), OPALE (PROLOG machine).

1. ARTEMIS Laboratory

Research Workshop for Systems Mathematical and Data Processing Techniques
Director: Jean Mermet (head of research)
UA 396 CNRS, Joint INPG and USMG Laboratory

36 researchers, including 12 who teach, 2 from CNRS and 2 from INRIA [National Institute for Research on Data Processing and Automation] researchers.

Research Topics:

General CAD tools (J. Mermet, J.P. Uhry)
- CAD and mathematics
- CAD workstation
- specification tools for interactive systems

Graphic processing (F. Martinez)

- machine architectures for realistic image display (HELIOS project, GETRIS Image)
- image synthesis software (CLOVIS)

Circuit and systems CAD

- modeling, simulation, testing, analysis, and synthesis (CASCADE project)

Socio-economic system modeling (MODULECO)

Representation and utilization of object-based knowledge (F. Rechenmann)

- SHIRKA project

2. LIFIA Laboratory

Fundamental Data Processing and Artificial Intelligence
Director: Philippe Jorrand (research director)
UA 394 CNRS--INPG Laboratory

50 researchers, including 10 who teach, 10 from CNRS, and 1 from INRIA

Research Topics:

Generic, functional, and logic programming (LPG) (D. Bert)

Functional and parallel programming (FP2) (Ph. Jorrand)

- communicating processes
- parallel programming
- behavior study (ESPRIT project)

Program deduction and synthesis (R. Caferra, P. Jacquet)

Formal computer languages and algorithms (J. Calmet)

Artificial Intelligence, robotics, and vision (J. Crowley, C. Laugier, A. Lux)

- specific areas of application: material handling robots, mobile robots, computer vision, production automation.

Automatic programming in robotics

- object grasping
- automatic generation of fixed trajectories and high-accuracy movement
- propagation of geometric uncertainties

Reason modeling and intelligent systems operating in a real environment

- generation of plans for action
- dealing with uncertainty
- time planning
- functional reasoning
- models for teaching robots

Musical and graphic data processing (C. Cadoz)

- design and production of a tool for artistic creation, based on the creation of music and animated images

3. Information Engineering Laboratory

Director: Jacques Mossiere (INPG professor)
UA 398 CNRS--Joint INPG and USMG Laboratory

83 researchers, including 43 who teach, 6 from CNRS, and 1 from INRIA

Research Topics:

Specification and analysis of data processing systems (J. Sifakis)

- modeling and programming of real-time systems, LUSTRE project
- algebraic methods for specification and verification of interactive processes (CESAR project)
- non-standard reasoning methods and verification
- program proof and complexity

Parallelism, communication, and integrated circuits (G. Mazare)

- interactive systems (formal programming, distributed applications, industrial local area networks)
- automatic generation of specialized integrated circuits
- integrated circuit CAD tools
- highly parallel architectures

Programming methodology (P.C. Scholl)

- programming training
- tools for man-machine communication
- computer-aided instruction

Intelligent information search systems (Y. Chiaramella)

- automated documentation (CONCERTO project)
- demographic databases

Databases (M. Adiba)

- generalized databases (TIGRE project)
- natural language processing and full-text databases
- logic and knowledge bases
- databases for CAD
- assistance in information systems design

Software and systems engineering (S. Krakowiak)

- local area networks
- structured object handling, document processing (EDIMATH)
- programming environments (ADELE project)
- operating systems
- languages and environment for logic and functional programming, specialized multiprocessor machine

Interactive systems for computer-aided decisionmaking (B. Oudet)

4. TIM3 Laboratory

Data Processing, Mathematics, Microelectronics, and Quantitative Microscopy Technologies
Director: Jean Della Dora (USMG lecturer)
UA 397 CNRS--Joint INPG and USMG Laboratory

138 researchers, including 38 who teach, 11 from CNRS, and 2 from INRIA

Research Topics:

Computer architecture (B. Courtois)

- integrated circuit architecture
- design methodology
- languages for circuit description and simulation
- "self-checking" systems theory
- fault modeling
- automatic circuit quality inspection

Projects: SYCOMORE, ADVICE (ESPRIT)

CMP service

Pattern recognition and quantitative microscopy (C. Bellissant)

- image analysis (approximation, segmentation, minimal representation)
- description, understanding, and AI (J.M. Chassery, C. Garbay)
- quantitative microscopy applications (G. Brugal), specialized analyzer (SAMBA)

5. Circuits and Systems Laboratory

Director: Gabrielle Saucier (INPG professor)
UA 395 CNRS--INPG Laboratory

43 researchers, including 7 who teach and 7 from CNRS

Research Topics:

Data processing systems modeling (M. Becker, P. Caspi, C. Robach)

- analysis and behavioral programming of real-time systems (LUSTRE)
- parallel systems performance evaluation
- testability and operational reliability

Design

- systems and VLSI architectures (WSI project)
- CAD and testing of VLSI

Mathematical modeling

- digital analysis (F. Chatelin)
- statistics (J.R. Barra)

6. Study Group for Automated Translation (GETA)

Director: Christian Boitet (USMG professor)
UA 826 CNRS--USMG Laboratory

Research Topics:

"Linguistic software" design and production

- representation and use of linguistic and extralinguistic knowledge (integrated dictionaries and semantics)
- environments and software tools for CAT [computer assisted translation] (ARIANE)
- specialized languages for linguistic programming
- formalizing and establishment of "static grammars" (GSCS)

7. Discrete Structures Laboratory

Director: Jean Marie Laborde (research supervisor)
UA 393 CNRS--USMG Laboratory

25 researchers, including 6 who teach and 4 from CNRS

Research Topics:

Matroid theory [theorie des matroides]

Ordered groups

Code theory

Graph theory

Data processing and physics applications (quasi-crystals)

CAD/CAM Research

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[Article by Claude Foulard, INPG (Laboratoire d'Automatique, BP 46, 38402 Saint Martin d'Heres): "University Research at Grenoble on Factory Automation"]

[Text] Factory Automation

In this text we use the term factory automation [FA] to mean everything relating to automation of the manufacturing process, ranging from product definition to production. The term automation must therefore be understood in the largest sense.

FA is therefore not a discipline but a crossroads, the confluence of various disciplines and technologies which all lead to a single objective. Such technologies, however, can clearly not benefit from FA until they are approached, developed, implemented, and used in an FA application. It can be in product design, CAD, workshop design (of varying flexibility), design of machines and robots along with their coordinated use in a workshop, workshop

management, production management, scheduling, operations research, machine specifications and control, machine installations, various forms of computer assistance (such as CAM, computer-aided production control, CAT, etc.), production engineering, quality control, maintenance, instrumentation, economic and social impacts, ergonomic aspects, data processing, robotics, AI, electrical technology, and all the disciplines contributing to the technology of materials and equipment involved in a production line.

The first consequence of this definition is obvious: Study and research on FA is spread over several laboratories. The second is that Grenoble cannot cover all aspects of FA: Its strong points include CAD, scheduling and management of production, simulation, specification of workshop and machine operation, robotics, electrical sensors and activators and vision, and, generally speaking, all software aspects of FA. In addition, social and human aspects are studied and, lastly, ergonomic and mechanical studies are being conducted.

Research Laboratories Involved

LAG (Automation Laboratory of Grenoble):

- Robotics and vision, quality tests, performance evaluation, flexible workshop simulation, specification and control of production systems, hierarchical production engineering and management.

ARTEMIS (Research Workshop for Systems Mathematics and Data Processing Techniques):

- Production planning and engineering, operations research, representation of solid objects, and CAD.

Software Engineering Laboratory:

- Databases, real time.

Circuits and Systems Laboratory:

- Reliability, highly dependable operation.

LEG (Grenoble Electrotechnical Laboratory):

- CAD, sensors and activators for robotics.

LIFIA (Laboratory for Fundamental Data Processing and Artificial Intelligence):

- Robotics and AI.

IREP Development:

- Socio-economic studies relevant to FA.

LAB-SY-S:

- Ergonomics.

GP M2 (Physical and Mechanical Materials Engineering):

- CAD for shaping sheet metal.

IMG (Mechanics Institute of Grenoble):

- Mechanical systems.

Counting only the people in these laboratories who work in FA, there is the equivalent of nearly 100 full-time researchers.

It should be noted that the principal research teams involved participate in the ARA [Advanced Automation and Robotics] program.

Finally, let us mention the project to create an FA-oriented scientific group. It would assemble all relevant research teams from the laboratories mentioned above, except LIFIA, which is already part of the IMI (Institute of Intelligent Machines) group. This goal is unfortunately difficult to achieve, given the dispersion of work relevant to FA. Our objective is to gather researchers from each of those teams to work on a finalized project: Indeed, fundamental studies have very little relationship from one team to another; it is the final applications of these studies which can have such a relationship, the link being the project, and the common objective, its conclusion. This also presupposes close cooperation with a manufacturer and suitable financial means which we have not yet assembled.

Signal Processing Development

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[Article by J.L. Lacoume, INPG-ENSIEG (ENSIEG, BP 46, Domaine Universitaire, 38402 Saint Martin d'Heres Cedex): "Signal Processing at Grenoble"]

[Text] All organic units (systems, individuals...) use signals to exchange information with their environment. The goal of signal processing is to provide for these exchanges and to optimize them, at both transmission and reception.

The nature of a signal derives from information, an entity which formalizes a system's perception of its environment, and maintains its content through highly varied physical media which use multiple means of transmission and processing. Thus, signal processing is indeed a multidisciplinary activity combining research in mathematics (pure and applied) and in physics (of waves and materials); it benefits from and plays a part in innovation in electronics and data processing. Innovative developments in signal processing therefore require a very rich environment, one at the forefront of discoveries in basic areas supporting its methodology and technological innovation which stimulate

new approaches. In the heart of a very rich university complex, the Grenoble area provides an intellectual environment favorable to the development of signal processing. Through its contact with the economic and cultural world it stimulates the creativity of researchers who face the risks and challenges of our evolving civilization.

Grenoble's Potential

The current importance of signal processing in Grenoble is the result of a long evolution which laid the foundation for the present situation. All of the fundamental aspects (both theoretical and practical) of signal processing have been extensively developed in Grenoble over the last 40 years.

The basic mathematical tools came out of the remarkable national and international success of the Grenoble School of Applied Mathematics, which created a dynamic and strong community. This intellectual potential in applied mathematics allowed Grenoble to enter data processing very early, resulting in the very strong network of facilities and contacts found within the local university and industrial sectors today. Electronics has also been one of Grenoble's strong suits for several decades. An enriching and active symbiosis exists between the economic, cultural, and university sectors. Many small-, medium-, and large-sized companies, as well as large governmental organizations, such as the CENG [Grenoble Nuclear Studies Center], are a part of these deep roots. In signal processing specifically, LETI [Laboratory for Electronics and Data Processing Technologies] plays a key role.

From these beginnings we can see the outlines of Grenoble's signal processing activities in an essential and fruitful balance between medium- and long-term intellectual investments and the need for applications on a local, regional, national, and international scale.

The intellectual investments which allow the consolidation of Grenoble's signal processing assets have been made in the two major areas of the discipline: methodology and processing devices.

Research

Strong basic research on mathematical tools is conducted primarily by the university (INPG and USMG) laboratories, heavily associated with CNRS. Current efforts focus on areas which have already become traditional:

- probability methods, probabilities, statistics, and theory of detection, estimation, and decision (TIM3-CEPHAG),

- algebraic methods, functional analysis, approximation methods involving Grenoble's specialization in spline functions (TIM3, CEPHAG, LAG)

- parallel methods for a multidimensional approach (LIFIA).

We also see the development in Grenoble of new directions in the study of:

- architecture: parallelism, systolic networks (TIM3, CEPHAG, ARTEMIS),

- formal computing (TIM3)

- nonlinear filtering (LAG, TIM3)

Applications

In our opinion, one of the keys to success is the direct link between the most theoretical level and applications. This link is assured by the contacts between different groups within the joint bodies or by restructuring a given group within a single body. We can cite the successful coordination between basic research on parallelism and on programming languages for algorithm development, which led to the development of new integrated circuits. We can also mention the creation of multidisciplinary research themes among which signal processing is one of the major areas in terms of the number of different disciplines involved (applied mathematics, data processing, physics, electronics, and biomedicine).

Signal processing applications at Grenoble are directly tied to local manufacturing, and they are supported by the large national organizations located in the area (CENG, CNET [National Center for Telecommunications Studies]). We also see solid involvement on the national level in coordinated projects: Formal Greco Computing [Greco calcul formel], Cooperation Competition Communication, Spoken Communication, and Adaptable Robot and Signal Processing Systems. Grenoble's national service initiative, aimed at opening university circles to integrated circuit design (multiproject circuits) gives an idea of the extent of the local environment's role in applications.

Two general signal processing applications are very actively pursued at Grenoble: speech and images.

Speech processing is under development at the Institute of Spoken Communication, where studies cover all the various aspects of this subject: phonetics, semantics, processing, and instrumentation.

Image processing is a major topic linking several laboratories (TIM3, LTIRF) and also involving teams more directly active in robotics (vision processing) and computer vision (artificial intelligence) (LIFIA).

Finally, those applications most readily implemented usually involve the assistance of one or more specific outside partners. A partial list includes:

- signal processing in underwater acoustics and in geophysics, a CEPHAG specialty;

- signal processing in biomedical imagery and fluid mechanics, handled by TIM3;

- development of signal processing instruments and circuits is a focus of most teams, but especially of ARTEMIS. This activity benefits directly from the facilities of LETI and EFCIS and of the national service of multiproject circuits (INPG).

We could also mention numerous university research projects which resulted in technology transfers with, for example, the SAMBA analyzer in the biomedical field (TIM3) and the collaborations with LETI on scanners and NMR [Nuclear Magnetic Resonance].

Finally, the Grenoble community has capably responded to the need for diffusion of knowledge and ideas within an evolving discipline with many players. The continuing education provided by INPG and USTMG includes a number of signal processing courses. Furthermore, by promoting the creation of a signal processing journal, primarily in French, Grenoble encourages national and international exchange.

Because it is multidisciplinary, modern, and of strategic importance, signal processing will be a key factor in mastering the future. Built on a solid base and stimulated by a large and varied community, signal processing in Grenoble is part of the national and international research effort in this field and contributes to the development of methods and means which support the evolution and the decisive changes in signal processing innovation.

Microelectronics Research

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[Article by P. Gentil, ENSERG-INPG (LPCS-ENSERG, 23 Rue des Martyrs, 38031 Grenoble Cedex): "Microelectronics at Grenoble"]

[Text] In this article, microelectronics is defined as the collection of sciences and technologies leading to the development of active components and integrated circuits. The Grenoble region contains a large proportion of the nation's activity in this field, whether in training, in basic or applied research, or even in manufacturing. Grenoble's microelectronics industry is heavily focused on silicon integrated circuits. It is an extremely dynamic high-tech field whose mastery assures success in many other economic sectors. It requires extensive basic and applied research capabilities and very large investments in industrial development and manufacturing facilities. Finally, personnel training is now recognized as one of the keys to success in microelectronics.

Training in Microelectronics

The ministries of National Education and of Industry and Research introduced a microelectronics training plan some years ago at the request of industry. Grenoble plays an important role in this plan.

Training programs have been created or developed, and a joint center with substantial facilities (CIME [Interuniversity Microelectronics Center]) was established for laboratory experience.

Students follow the training programs of their own institutions: the National Polytechnic Institute of Grenoble (INPG) or the Scientific and Medical University of Grenoble (USMG). Some 150 students are trained as microelectronics specialists each year with laboratory coursework done at CIME.

INPG:

Three INPG schools are involved: ENSERG (electronics and radioelectricity), ENSIMAG (data processing and applied mathematics), and ENSIEG (electrical engineering).

In addition to its traditional training of engineers, the INPG organizes continuing education sessions (of 1 to 3 weeks) in microelectronic technology and in integrated circuit design. The INPG also prepares engineers with double specializations by providing a special one-year program in microelectronics. Finally, training through research (doctoral level) is also important.

Historically, the ENSERG was the first to offer advanced specialization in microelectronics. The first 2 years at ENSERG provide a solid broad foundation to the 40 students, who then choose one of two 3d-year options: microelectronics or integrated circuit design. These two programs offer a full range of courses and lab work in technology and design of integrated circuits.

The microelectronics program is supplemented by training in physics and in description of components and technologies, while the IC design program offers exposure to electronic systems.

At ENSIMAG, the general data processing training of the first 2 years is rounded out in the 3d year by electives in CAD tools and in design and testing of complex integrated circuits. This training relies on the size and competence of ENSIMAG research teams specializing in integrated circuit design. One of these research teams established a national service, the CMP (Multiproject Circuit), which allows integrated circuits designed by many users (in France and elsewhere) to be brought together in manufacturing lots, thus allowing a few prototypes of each circuit to be made at low cost. Training in gate array technologies is also an area of major development.

At ENSIEG, training in physical engineering leads to an optional components program in which a selection of courses and lab work prepares specialists in the physics and technology of silicon integrated circuits. The training also covers compound semiconductors, optoelectronics, and guided optics.

USMG:

Two types of training are offered to students at the university: short programs in the University Institutes of Technology (IUT) and longer studies in the undergraduate, master's, and DEA (Diploma of Advanced Studies) sequence. Coursework and laboratory experience for the DEA in Microelectronics (which is common to the USMG and the INPG) include a basic program and two options: one aimed at circuit technology and the other at integrated circuit design. The training is supplemented by a laboratory internship, and about half of the 40 to 50 graduates each year pursue doctoral studies.

The IUT's offer more specialized training. The IUT for Physical Measurement prepares students for careers in technology and description, while the IUT for Electrical Engineering prepares its students in integrated circuit design.

CIME--Interuniversity Microelectronics Center:

CIME is one of three major French centers for microelectronics training. It is the interuniversity technology center for the Rhone-Alps region and has major experimental facilities for design, manufacturing, description, and testing of silicon integrated circuits. Besides the users mentioned above, CIME also accepts students from institutions in Lyon and from the National Advanced Telecommunications School of Brittany. In all, there are 250 students each year conducting specialist laboratory studies at CIME. In addition, 150 students do introductory level lab work in microelectronics: mask and gate array design, and hybrid circuits. CIME also accepts more than 100 interns in continuing education programs, offers technical support to university research laboratories, and works directly with industry, especially with small companies and services firms.

Microelectronics Research

The Grenoble region has a large share of France's silicon microelectronics research capability ranging from the most basic research to industrial development. We will limit this discussion to the activities of laboratories working primarily in microelectronics. There are three primary types of laboratories working in Grenoble: university laboratories, the Norbert Segard Center (CNS) of the National Center for Telecommunications Studies (CNET), and the Laboratory for Electronics and Data Processing Technologies (LETI) of the Atomic Energy Commission (CEA). Research and industrial development will be covered in the section on manufacturing. The role played by these laboratories goes far beyond Grenoble itself: They have a national calling, even a European one. The university laboratories work at a more theoretical level than the LETI and the CNET, but their activities are coordinated with those of these organizations by a national body, the GCIS (Silicon Integrated Circuits Group). Other agreements, either bilateral or multilateral, define the collaboration between the various laboratories.

CNS--CNET:

All the work of the 300 employees of the Grenoble center is focused on silicon integrated circuits. CNET works in the development of tools and circuits. Know-how and technologies must be transferred to French industry for it to reach the "cutting edge" of this high tech field. Applied research deals with the design, testing, and production of very highly integrated MOS circuits, linked to the construction of integrated circuit manufacturing and description equipment. CNET places particular emphasis on telecommunications applications of integrated circuits. In addition, a significant portion of the activity concerns basic research into longer-term applications.

CNET has signed cooperation agreements with Matra-Harris Semiconducteur to develop micron-level CMOS circuits and with Thomson for a signal processing microprocessor. CNET also signed a preliminary agreement with Thomson establishing R&D cooperation on silicon integrated circuits.

In addition to its involvement in national and European projects, CNET has ongoing contacts with many other foreign countries, including the PRC, which is in a favored position as the result of a very large technology transfer from CNET.

A second block of buildings is under construction at CNS. Its completion will permit raising staff to 500 and expanding research efforts in certain fields.

LETI--CEA:

LETI is attached to the Institute for Industrial Research and Development (IRDI). With staff of around 600, LETI is involved in a wide range of activities, going beyond the limits of microelectronics as defined above. LETI conducts studies in three areas: materials, components, and instrumentation and systems.

In the materials sector, LETI carries out research and develops new materials (ceramics, crystals) for all French research requirements. This activity also involves the manufacture and sale of crystals by CRISMATEC, which was created by LETI/CEA.

The components sector includes a major microelectronics laboratory, which led to the creation of EFCIS [Company for the Study and Manufacture of Specific Integrated Circuits] some 10 years ago. Located in new facilities, silicon microelectronics has recently seen new and important developments. The primary objective is to master advanced integrated circuit technologies. Among LETI's many cooperative projects with industry, we should mention an agreement with Thomson Semiconducteurs aimed at developing advanced integrated circuit technologies for application to industrial assembly lines. To this end, a technological workshop has been installed at LETI, run by Thomson personnel under LETI's direction. The components sector also covers magnetic microelectronics, the Josephson effect, display, sensors, and components and integrated circuits for infrared imagery.

The University Laboratories:

It is particularly difficult to define the boundaries of microelectronics in a university environment. Microelectronics is often seen as closely related to basic disciplines, physics, data processing, chemistry.... Manpower in this field can be figured at around 150 people (250 if research on materials for microelectronic applications is included).

Several laboratories of the IMAG (Data Processing and Applied Mathematics of Grenoble) institute are conducting research into the architectures and testing of complex integrated circuits and are developing new methods and tools for CAD of integrated circuits. This research is aimed at very complex integrated circuits. Here, integrated circuits are actually produced in order to test methods and tools. CNRS established the Integrated Systems Service Unit (USSI) at INPG to coordinate the scientific activities of different teams.

In physics and microelectronics technology, many research areas are handled by more than one laboratory. They deal with the physics and modeling of silicon-based submicron-level components, and with new structures and new methods for producing materials for integrated circuits. In addition, studies are conducted on compound semiconductors, microwave circuits, guided optics, amorphous silicon, sensors, displays, etc. The laboratories primarily involved in microelectronics are: ENSERG's Semiconductor Component Physics Laboratory, CNRS' Laboratory for the Study of the Electronic Properties of Solids (associated with USMG), and ENSERG's Microwave Electromagnetics and Guided Optics Laboratory. Many other groups are working on microelectronics at the INPG, USMG, and CNRS laboratories. CIME's facilities are frequently used by the university laboratories, both in technology and in integrated circuit design.

Microelectronics Manufacturing

A large part of Thomson Semiconducteurs facilities are located in Grenoble, providing a major presence of the French integrated circuit industry.

The Bipolar Integrated Circuit Division (DCI) is located at Saint Egreve, near Grenoble. It produces linear circuits for both consumer and professional applications as well as digital circuits such as programmable read-only memories and microprocessors. The Military and Space Division (DMS) is at the same site. It produces high-quality, reliable circuits. It is involved in the Ariane, Airbus, Meteosat, and other programs. A new factory under construction at Saint Egreve will unite custom circuit activities.

At Grenoble, the EFCIS division produces MOS circuits. The product line includes microprocessors and their peripheral equipment, and circuits for applications in telecommunications, data transmission, computerized telecommunications, and man-machine interfaces. EFCIS also offers electronic systems on European format cards. Thomson offers a wide range of custom "gate array" type circuits, both logic (CMOS and ECL-TTL) and analog, as well as full custom circuits in both MOS and bipolar technologies. Thomson Semiconducteurs also has its technical management in Grenoble, which handles R&D for the various divisions involved. This makes it possible to implement

research-generated innovations (LETI, CNET...) in the assembly lines of various production units. Its major activity is the development of different generations of MOS and bipolar integrated circuit technologies. These technologies are first used to develop circuit prototypes (LETI workshop), then, about a year later, they are put into mass production on industrial assembly lines.

Thomson recently bought the American Mostek company. This will surely lead to major changes in the roles of each division of Thomson Semiconducteurs.

Thomson is also in St. Egreve with the Electronic Tubes Division (DTE), which works in image recording and display devices. Electronic tubes are replaced by solid-state components whose technologies are very similar to those of microelectronics. Sensors and screens are going through a period of change; DTE is evolving rapidly.

Alongside the giant Thomson, small companies are being created and developing. The DRAXY services company, for example, whose activities are directed toward gate array networks, and DOLPHIN, one of the newest companies, which offers complete integrated circuit design to its customers.

Finally, many small- and medium-sized companies have become very active in areas related to microelectronics: electronic systems and equipment for microelectronics.

CNET Telecommunications Projects

Le Chesnay BULLETIN DE LIAISON DE LA RECHERCHE EN INFORMATIQUE ET AUTOMATIQUE in French Jun-Jul 86 pp 23-25

[Unattributed article written in October 1985: "CNET--The Norbert Segard Center of Grenoble", Chemin du Vieux Chene, BP 98, 38243 Meylan Cedex]

[Text] CNET, National Center for Telecommunications Studies, employs 4,000 in its seven centers located in greater Paris, Brittany (Lannion and Rennes), Grenoble, and Caen.

Under the May 1977 Components Plan, one of whose objectives was to increase French R&D capability in all areas of microelectronics, it was decided that CNET would create a research center specializing in silicon microelectronics and integrated circuits; then it was decided that this new center would be located in the Grenoble area.

CNET-Grenoble was thus established in the ZIRST (Zone for Scientific and Technical Innovation and Products) in Meylan; it actually began research in temporary quarters in 1979 and was inaugurated in its present facilities in February 1981.

Objectives

The center's objective is to conduct the various aspects of research in silicon-based microelectronics. In most cases, the final goal of these studies is to transfer knowledge to industry.

CNET-Grenoble has always believed that it should validate advanced research in integrated circuit design and technology through the actual production of complex circuits: It therefore built a pilot workshop, a true production line for highly integrated circuits, which has been in operation since December 1981.

The primary objectives of the center are:

- development of advanced IC technologies resulting in the production of complex circuits in the center's pilot workshop;

- research in computer-aided IC design and in new design techniques adapted to new technologies. Both types of research are validated through the actual design of complex circuits;

- physics and technology research leading to the improvement of basic technologies and the creation of models of new machines for microelectronics technologies (France is still very dependent on foreign sources in this area).

Facilities

CNET-Grenoble currently has 310 employees including 170 engineers and management.

Spread through five buildings, the facilities have a total usable area of 9,100 sq m, including 1,090 sq m of clean room.

Investment has been and is still substantial: Excluding salaries, the center's 1984 budget was close to Fr 96 million, and its costs since its creation is now close to Fr 600 million.

A second construction phase (two modules and a lecture hall, with usable area of 3,300 sq m) will soon begin and will allow the center to increase its staff by 100.

Major Results and Projects

Technologies and circuits:

In late 1982, CNET-Grenoble developed 3-micron NMOS [N-channel MOS] technology. (Footnote) (Important comment: The size indicated in the text always refers to the design width of the MOS transistor gate, and not to the channel's electrical length, which is less. CNET therefore speaks of "micron-level technologies" when actually submicron-level channel lengths are involved.) This technology has been used in numerous circuits since 1983:

telephone coders and decoders with digital filtering, (digital COFIDEC), signal processing microprocessor with a 70,000-transistor circuit, bus interface [arbitreur de bus] for the SM-90, raster extractor [extracteur de trame] for the Joint Center for Television Transmission and Telecommunications Studies [CCETT]; multiproject circuits of interest to several French university bodies; multipliers, adders, etc....

In 1983, CNET-Grenoble resolutely turned to CMOS technologies, in accordance with its 1983-1986 development plan, whose objective is development of micron-level CMOS technology labeled "Telecommunications" (CMOS T), aimed at logical, analog, or mixed analog/digital applications.

The first version of the CMOS Telecommunications technology (CMOS T3) is now complete; it has led specifically to the creation of 8-bit digital to analog converters operating at 18 MHz.

Their success in constructing a 1.5-micron (see previous footnote) logical CMOS technology has been proven by the production of 10 consecutive runs (from late 1984 to April 1985) containing enough good chips in the validation circuit for quality to be measured.

It is important to mention that this validation circuit is unique: It is a broadband switching matrix with 16 input and 16 output ports, allowing the switching of 16 digital channels with a capacity of at least 108 megabits per second. (In fact, it has already operated at up to 160 megabits per second.) This demonstration has proven that it is possible to create rapid circuits in CMOS (the same circuit in bipolar ECL technology would have 20 times greater power consumption).

Efforts are now being made in micron-level, logical, and "Telecommunications" technologies. The first 1-micron CMOS (see previous footnote) run, for use in functional circuits, has been produced by the pilot workshop. Currently (October 1985) the first batches are being processed. They contain complex circuits in 1-micron bimetal CMOS technology. This technology will be validated in the second half of 1986 using a circuit which contains several hundred thousand transistors) and it will be transferred to Matra-Harris Semiconducteurs [MHS]. The Telecommunications version will be assembled in 1986 and then validated using a videocommunications decoder; it will also be transferred to MHS.

Cassiopee

Cassiopee, a result of the center's research in CAD for integrated circuits, is a system whose major innovation is that it combines all representations of the circuit to be designed in a single database and offers a single descriptive language and a single command language to the designers; in addition, it verifies the coherence of the various representations. Using this system which makes integrated circuit design simple, fast, and reliable, non-specialists will ultimately be able to custom design circuits themselves, and this process will be easier than designing a gate array circuit today.

MUPTS, CNET's Signal Processing Microprocessor

This 70,000 transistor circuit can now be made in 3-micron NMOS technology. Compared to circuits of the same type now on the market, it has several original features: Its development system is very complete, its high performance programming language uses the conventional functions available in the most widely used data processing languages, and it is not based on a standard microprocessor. Its performance has been demonstrated in a fairly complex pilot application: the 4,800 bps V-27 ter modem.

Given its functions, it only has two serious competitors on the market (Fujitsu and Texas Instruments circuits); reformatted in 2-micron CMOS technology, it could capture a significant portion of the world market.

Titan and Jupin:

CNET-Grenoble has developed simulators of basic devices at both the manufacturing process (Titan) and the electrical operation (Jupin) stages. Several semiconductor manufacturers are evaluating these extremely original software products.

Some Outstanding Results in Physics and Technological Research

Silicon on insulator (SOI):

A manufacturing process has been developed to obtain a thin film of monocrystalline silicon on an insulator, on 100-mm plates, using a lamp-based annealing system. The material is presently being introduced in the field for final validation. A cooperation agreement on this subject has been signed with Thomson Semiconducteurs.

SMS (silicon-metal-silicon) transistor:

CNET-Grenoble created the first SMS transistor in the world; the laboratory is currently making transistors whose metal base is from 50 to 200 angstroms thick. This type of transistor, which is very fast, should be suited to hyperfrequency and high capacity systems applications.

Lithography and submicron engraving:

Equipped with an electronic masking device and high-performance etching frames, the center has created NMOS transistors with a gate size of 0.2 microns and has been able to measure their characteristics, which are satisfactory.

Multipolar plasma development using microwaves:

Obtaining homogeneous plasma in large volume by confinement in a multipolar magnetic structure is itself a very original study; the application of this technique to anisotropic etching has produced very good results, and it can also be used for deposition and oxidation.

Microbeam laser machine:

Used to detect susceptibility to "latch-up" (proximity effect) in certain areas inside an integrated circuit, this original application is of great interest to manufacturers, especially of CMOS circuits.

Automatic measurement of line width:

This machine is also very original because of its use of signal processing to calculate width. It allows measurement of features in the 0.7-to-10-micron range, accurate to within 1 percent.

CNET-Grenoble research teams have developed a very effective method for describing materials and have acquired great expertise in the study of macrophysics (diffusion, silicides, etc.).

CNET-Grenoble's Major Industrial and International Relationships Involving Technology Transfer and Collaboration

An agreement for collaboration was signed in late 1984 between CNET and Matra-Harris Semiconducteurs for the development and manufacturing of micron-level CMOS technologies as of late 1984: It was under the terms of this agreement that the 1-micron bimetal CMOS and the 1-micron CMOS Telecommunications technologies discussed above were transferred to MHS.

A basic cooperation agreement was signed with Thomson-Semiconducteurs; specific agreements followed: one covering silicon on insulators and one on the description of silicon material. Other agreements, either signed or in preparation, cover CAD software, device or process simulation, microbeam laser testing, etc....

Agreements to collaborate on certain basic technologies are being prepared with some hardware manufacturers.

The Cassiopee system is the basis for the Coralie national project, whose participants are CNET, APSIS (which sells the system), Matra-Harris Semiconducteurs, and Electronique Serge Dassault. The final goal is to sell systems software on a totally French workstation. APSIS is already selling software products, such as Eldo, an extremely high performance electric simulator created at CNET.

Cassiopee is also the basis for the European CVT (VLSI-CAD for Telecommunications) project, in which CNET's major partners are CSELT (Italy's equivalent of CNET) and the Research Institute of the German Post Office. In late 1985, this project will be followed by the CVS project, within the framework of ESPRIT.

The Basil software for monitoring production runs in the pilot workshop is being marketed by Semy Engineering.

Several machines designed at CNET have been manufactured and marketed: a laser marking machine, a spectroscopic ellipsometer, and a machine to clean

silicon tubes in furnaces. Negotiations are currently underway concerning transfer of several machine models to industry for production.

CNET is also involved in several ESPRIT projects; it is the prime contractor for the Spectre project (0.7-micron CMOS), with MHS and Bull in France, SGS Ates and CSELT in Italy, British Telecom, and the Belgian universities IMEC and UCL as its partners; it will be heavily involved in the CVS (VSLI-CAD for Systems) project, which is based on Cassiopee and whose partners are CSELT and GMD [Association for Mathematics and Data Processing], the FRG equivalent of INRIA [National Institute for Data Processing and Automation Research]; it is also involved in the Advice project (automatic integrated circuit testing by scanning electron microscope), etc....

Conclusion

With its 310 employees, CNET-Grenoble is by far the largest French public research center completely devoted to silicon microelectronics. It was not possible to describe all its studies and findings within the scope of this article.

The combination of specializations in circuits, technologies, and basic research has allowed the Center to attain an excellent international level in 6 years. This is demonstrated by the considerable growth in contractual, manufacturing, and international relationships which it has experienced over the last year or so.

LETI R&D Programs

Le Chesnay BULLETIN DE LIAISON DE LA RECHERCHE EN INFORMATIQUE ET AUTOMATIQUE in French Jun-Jul 86 pp 26-27

[Unattributed article: "LETI (Electronics and Data Processing Technology Laboratory)," Avenue des Martyrs 85, 38041 Grenoble Cedex)]

[Text] LETI is an applied research laboratory in the electronics and data processing fields. Created within the Atomic Energy Commission [CEA] in 1967, it is located at the Nuclear Studies Center in Grenoble [CENG]. With over 600 employees, its activities cover a complete developmental spectrum ranging from basic materials to components and, finally, to complex electronics systems.

It maintains close ties with universities and industry, and generally with all French laboratories, both public and private, involved in electronics research in a variety of different capacities.

It participates in technology transfers to industry.

It undertakes R&D projects in materials, components, and systems for scientific organizations and manufacturers.

It acts as a "pivot" between basic research (CNRS-university) and manufacturing (industry).

Outlines of research programs are submitted to a scientific planning committee which includes, besides the relevant CEA directors, those of the public organizations involved in electronics (CNET, CNRS, DAII, DIELI, DRET, INSERM, PMFE), as well as a representative of industrial organizations (GIEL). The composition of this committee demonstrates the connection of LETI's activities to France's overall electronics policy.

LETI is also active on a European level and participates in coordinated studies with partners in various EEC countries.

LETI's activities are focused on the following three areas:

Materials

Areas of expertise:

- methods and means to develop new materials for use in electronics and optoelectronics,
- finishing methods and means (shaping and polishing),
- description,
- marketing under the CRISTAL-TEC brand.

Programs:

- semiconductor materials for integrated circuits, optoelectronics, display screens, and infrared devices,
- magnetic materials for bubble memories, ultrahigh-frequency devices, disk memories, magneto-optical devices,
- piezoelectric materials for surface or volume acoustic wave devices, electrooptic modulators, optical frequency multipliers,
- materials for high power and tunable lasers,
- materials for radiation detectors.

Component Technology

Areas of expertise:

- studies of physical phenomena,
- basic technologies (at submicron level: etching, deposition, implantation, annealing, modeling...),
- assembly of new circuit technologies.

Programs:

- silicon integrated circuits (MOS): basic research, technological workshop, "prototype" workshop (integrated circuit production using emerging technology for small runs),
- magnetic bubble memories,
- magnetic recording,
- components for infrared image detection,
- complex display screens,
- sensors,

- guided optics components,
- connection techniques.

Instrumentation and Systems

Areas of expertise:

- image detection and devices: nuclear, photonic, and magnetic devices,
- image processing,
- artificial vision,
- robotics,
- high-speed electronics.

Programs:

- scientific instrumentation (magnetometry, particle locating, signal processing),
- medical instrumentation (radiography, tomography),
- industrial instrumentation (non-destructive quality control, robotics),
- extreme environment robotics (nuclear, chemical, space, and shallow and deep marine robots).

LETI, with its 600 employees including nearly 250 engineers and researchers, has over 25,000 sq m of space, including some 2,500 sq m in clean rooms.

It has contractual ties to more than 50 companies located primarily in the areas of the Ile de France and Rhone-Alps. It makes a significant contribution to the development of new technologies in small- and medium-sized companies as well as in large industrial groups.

Bull Projects

Le Chesnay BULLETIN DE LIAISON DE LA RECHERCHE EN INFORMATIQUE ET AUTOMATIQUE in French Jun-Jul 86 pp 28-29

[First part of excerpted article: "Grenoble Companies of International Importance"]

[Text] BULL-SEMS (Les Bureaux du Parc, 36, 38 rue de la Princesse, BP 4, 78430 Louveciennes).

For nearly 20 years, BULL SEMS has been working in real-time minicomputer development in the Grenoble basin.

This activity, which arose from local university/industry collaboration, has led to the development of human and technological resources resulting in the creation of several generations of products and many companies in the areas of scientific and technical data processing: real-time industrial applications, process control, computer-aided engineering and design (CAE/CAD), and communications.

BULL SEMS

BULL SEMS entered the Bull group in 1983 with nearly 1,000 employees. It is responsible for the mini- and mega-minicomputer lines for scientific and technical purposes.

To date, the two industrial units located at Crolles and at Echirolles have produced more than 15,000 systems which are scattered throughout the world.

These two units and the technical center in Echirolles are responsible for the BULL Mitra, SPS-5, SPS-7, and SPS-9 products.

BULL

This line of 16-bit minicomputers is aimed at the following applications:

- real-time data processing base,
- transactional management with database (TEMIS) and disk accelerator (DIRAM), communications and networks.

BULL SPS-5

This line of 16-bit minicomputers emerged from the SOLAR products and is used in industrial and scientific-industrial real-time applications. BULL SPS-5 falls within the centralized stand-alone systems or distributed systems architectures, integrating specialized industrial local area network interfaces.

BULL SPS-7

This line of 16/32-bit modular minicomputers is based on a multi-microprocessor architecture, designed under CNET's SM-90 license (Footnote 1) (CNET: National Center for Telecommunications Studies). Its operating system, based on UNIX (Footnote 2) (UNIX: Trademark of ATT/Bell Laboratories), is rounded out by a real-time monitor and a wide range of basic and applicational software packages.

This product can be used for real-time applications in scientific and industrial environments, for telecommunications, and for technical applications: computer-aided engineering and design (CAE/CAD)....

The BULL SPS-7 has been the target of extensive porting of specialized packages resulting from collaboration with ADI (Footnote 3) (ADI: Data Processing Agency) and from complementary development arising from cooperation with GIPSI (Footnote 4) (GIPSI: Public Interest Group for Science and Data Processing) and with SSII's [Data Processing Services and Engineering Companies].

BULL SPS-9

This line of 32-bit modular mega-minicomputers is the product of technological, industrial, and commercial cooperation with RIDGE computer. It

has a RISC (Reduced Instruction Set Computer) architecture with a limited instruction code. It performs remarkably well in executing programs written in high level language. It has a virtual memory and a ROS operating system based on UNIX.

The BULL SPS-9 is produced on assembly lines in factories in the Grenoble area. It is used in science, CAE, and CAD applications, as well as in systems requiring a powerful UNIX driver.

In addition, the BULL SPS-7 and SPS-9 offer high level languages ("C," FORTRAN 77, and PASCAL) and an AI environment (LISP and PROLOG) as well as major connecting interfaces for the ISO/DSA, X.25, Ethernet local area networks (Footnote 5) (ETHERNET: Trademark of RANK XEROX), DR-11-W....

Finally, the software packages for scientific, CAE, and CAD applications as well as specialized hardware interfaces round out Bull's offerings--the so-called "Bull solutions." They have been developed through cooperation with SSII's and systems integrators.

Role of the Technical Center

The BULL SEMS Technical Center conducts the activities essential to developing the aforementioned products: increased computing power, integration of black-and-white and color graphics terminals, the creation of new instrumentation couplers (IEEE), of industrial communications and networks, and the coordination of the SPS-7 and SPS-9 lines....

The BULL SEMS Technical Center is involved with many research programs, such as ESPRIT, especially in the areas of communications and industrial local area networks. It also conducts research for other Bull products, for example, in artificial intelligence....

A center for UNIX expertise, created within BULL's Technical Center, is responsible for providing technological expertise and consistent methodology, and for representing BULL with user groups.

In addition, in order to increase the efficiency of both its products and customer service, BULL SEMS initiated a major quality improvement program in 1984.

Thomson Semiconducteurs Projects

Le Chesnay BULLETIN DE LIAISON DE LA RECHERCHE EN INFORMATIQUE ET AUTOMATIQUE in French Jun-Jul 86 p 32

[Second part of excerpted article: "Grenoble Companies of International Importance"]

[Text] Thomson Semiconducteurs (101, Bld. Murat, 75781 Paris Cedex 16, Tel: (1) 47 43 96 40)

Research and Development Strategies

Thomson is capable of a global approach to R&D thanks to its advanced product (or pilot project) strategy, which is based on utilization of multiple innovation sources in a well-defined product line.

This program is being carried out jointly with INPG's TIM3 Laboratory, BULL, and INRIA.

In the area of CAD, an ongoing dialog and exchange of software is carried out with CNS. Thomson and CNS are furthermore responsible for the two national programs in CAD presently underway.

Technologies

These are part of the global approach and must fulfill the requirements of advanced MOS, BIP, BIMOS, SOI, etc. products, meeting essential objectives such as high-speed performance, power consumption, miniaturization, or voltage capacity, depending on the field involved.

To this end, the most capable technicians use the most advanced equipment and procedures to ensure optimum processes, prototype construction, and transfers to industry.

In this sector, cooperation with the following teams is particularly important:

- LETI, with which an MOS Association has been created for micron-level CMOS technology and prototype development,
- CNS, on advanced technologies (SOI), materials, and description techniques,
- Thomson's Central Laboratory for new materials and processes.

Advanced Products

One example: SCQM

A data processing machine capable of supporting the complex information processing requirements of the 1990's. It features:

- high performance,
- management of large masses of data,
- coherence and sophisticated protection of data,
- flexible architecture and computing power,
- failure tolerance,
- extreme miniaturization.

It will be able to handle future applications such as:

- air traffic control,
- weapons systems,
- telephone exchanges,
- control, design, and decisionmaking aids (expert systems, AI).

This program is being pursued in cooperation with the Thomson Central Laboratory (System Study) and the INPG's TIM3 Laboratory (Testability).

CAD Tools

The SYCOMORE program is aimed at high efficiency and reliable design. To satisfy needs arising in the design of very complex circuits of a million transistors, it uses hierarchical design, logic-assisted synthesis based on behavioral description, and symbolic description and verifications.

SYCOMORE uses silicon compilation and expert system technologies.

Cap Gemini Research

Le Chesnay BULLETIN DE LIAISON DE LA RECHERCHE EN INFORMATIQUE ET AUTOMATIQUE in French Jun-Jul 86 pp 33-34

[Third part of excerpted article: "Grenoble Companies of International Importance"]

[Text] Cap Gemini Sogeti (6, Bld. Jean Pain, 38000 Grenoble, Tel: 76 44 82 01)

A Grenoble Success on a World Scale

In 1967 in Grenoble, Serge Kampf and several of his friends founded SoGETI, a company which would supply the consulting and support services not offered by manufacturers to computer users, who were rare in those days.

Except for a few pioneers, led by CAP, the Center for Analysis and Programming which was created in 1962, few people were at that time farsighted enough to think that a new trade--data processing services and consulting--was being born and that the exercise of this trade would become one of the foremost French successes of the latter part of the 20th century.

Five people at start-up in 1967, 7,000 20 years later; a small, regional company in 1967, a multinational making two-thirds of its Fr 3 billion sales outside of France; locations from San Francisco to beyond the Arctic Circle, but still managed from Grenoble by its founder; a range of services covering all possible information assistance in data processing, from console operations assistance to overseeing operation of the largest network in the world, the Electronic Telephone Directory; a "family" company with its directors holding two-thirds ownership, but ranked third internationally in the business in terms of size, and first in terms of territory covered; this is the sometimes paradoxical story of the SoGETI company, which became the Cap Gemini Sogeti Group over the years as a result of mergers.

The Grenoble Area

Although the Group's headquarters is located in Paris for the sake of convenience, Grenoble is still the center of the network which covers France,

Europe, and the United States, thanks to some 100 agencies, themselves combined into companies, which make up the basic operational units.

Of course, Grenoble is home to one of these agencies, which like all the French agencies outside of Paris, reports to the Cap Sogeti Systemes company.

Manned by a staff of 80 and directed by Patric Barberousse, it has, like its sister agencies, a size which allows it to remain fully dedicated to team work, an essential idea within a company whose true wealth is its human resources.

Area of Specialization

It provides all data processing information services to assist area companies from Haute Savoie to Ardeche. The agency director, aided by his marketing engineers, is essentially the customer's only direct contact, regardless of the problem to be handled. He is responsible for mobilizing the necessary talent, wherever it may be within the Group.

Also at Grenoble--or more precisely at Meylan, in the heart of the ZIRST--is the Group's research center, attached to the company Cap Sogeti Innovation.

In the world of data processing services and consulting companies, this company has no equal. Its primary job is to prepare the Group to implement advanced technologies: to select technologies according to their level of development and their importance for the development of the Group, to acquire an expertise in their implementation, and to disseminate this know-how throughout the Group. Its main energy is concentrated at the Grenoble Research Center (CRG), whose presence in Grenoble is due in part to the history of Cap Gemini Sogeti, but also largely to the quality of the Grenoble environment in the areas of data processing training and research, as well as to the abundance of ideas generated by the ZIRST at Meylan.

Research

Directed by Maurice Schlumberger, the CRG consists of some 30 high-level engineers of all backgrounds and nationalities. There are Swedes and Americans along with a majority of Frenchmen, many of whom are graduates of the ENSIMAG and the INPG.

The CRG's activity revolves around four major areas: software engineering, AI, man-machine communications, and operational reliability.

Software Engineering

Work in this area, driven by the desire to lift software development into the industrial area, concentrates primarily on tools to improve productivity and to assist in project management.

Taking priority, two large projects lead this development:

CNET's CONCERTO Project

The CRG played an important role in:

- generation of a multitarget code (ADELE),
- development of structured document and diagram editors,
- specialized workstation for the CHILL language.

ESPRIT Project No 401

This was described in an earlier issue (Footnote) (Number 105 of the BULLETIN DE LIAISON of January 1986), along with the company's other ESPRIT projects.

At a lower priority level, the ESPRIT PIMS project is the focus of this activity.

In addition to these major concerns there are two more limited fields of activity:

- parallel computing (based on ESPRIT project No 302),
- developments in Ada.

Artificial Intelligence

This activity is divided into expert systems and natural language processing.

Expert Systems

Basic work in this area (ESPRIT ESTEAM project Nos 1098 and 1220) underlies the development of applications for the growing number of customers, especially in the areas of diagnostics and maintenance support. Cap Sogeti Innovation's past activities allowed the Group to make a grand entrance into this market as of 1986, a market which is just beginning to grow.

Natural Language Processing

The CRG is basically targeting the market for [man-machine] communication interfaces for data processing applications. The technologies used--especially functional description--have allowed them to successfully develop applications in the fields of document queries (automatic indexing, inquiries in natural language) and computer-aided translation [CAT]. The addition of a French dictionary to the development tools will be one of the principal activities of 1986.

Man-Machine Communication

This subject adds a multimedia dimension to that of natural language use in interfaces and aims at establishing a development philosophy for those interfaces, based on consulting activities. This leads to both greater

user friendliness in data processing and more software independence between the application and the communication which allows it to be implemented.

Operational Reliability

This field was introduced in 1986. It aims at giving the Group expertise in all technologies which could be utilized either for data processing system reliability or security. No more can be said at present, as precise orientations are still being defined.

Thus, from the origins of the Group to its entry into the most advanced fields of software technology, the path of Cap Gemini Sogeti goes through Grenoble.

25051
CSO: 3698/A079

BRIEFS

ULTRAPURE ALUMINUM FOR SEMICONDUCTORS--Paris--Aluminum Pechiney announced the production of a new variety of "ultrapure" aluminum produced in its Mercus factory (Ariege) which is "designed for the new generations of integrated electronic circuits." More specifically, the future 1 and 4 megabyte memories should benefit from this new material which is used to separate semiconductor layers, thereby eliminating in large part the particles emitted by certain impurities commonly found in aluminum (uranium and thorium). The passage of the released particles ordinarily causes disturbances and "random errors" in the thin layers of these miniaturized electronic circuits. The new principle implemented by Pechiney for producing its "ultrapure" aluminum was developed in the firm's research center in Voreppe (Isere). Several hundred kilograms will be produced annually in a market where Pechiney will initially be the sole supplier. [Text] [Paris AFP SCIENCES in French 22 Jan 87 p 29] 12798/9869

FINNS BUILD ELECTRONICS PLANT IN USSR--Finns will find work in the Soviet Union when Finn-Stroi...builds an electronics factory in Moscow together with TM-Engineering...The electronics factory in Moscow will manufacture diskettes for microcomputers. The project is worth around 200 million markkas. Construction of the factory, which should be complete by the summer of 1988, has already begun. During the most intensive phase around 200 Finns will work on the site. In addition the project will also indirectly employ around 800 eople in Finland for a year. [Excerpts] [Helsinki HUFVUDSTADSBLADET in Swedish 21 Mar 87 p 12]

CSO:3698/371

ROBOTICS FAIR TO BE HELD IN LENINGRAD

Milan RIVISTA DI MECCANICA in Italian Oct 86 p 105

[Text] Roboter '87, the fourth Exposition of this robotics Fair, will be held in Leningrad from 1 to 9 July 1987. Exhibiting at this fair will be 220 exporting firms from 14 Western countries. The products exhibited will provide a preview of the USSR's future investments in this field. The Exposition, which will be accompanied by a Symposium, will provide an optimum opportunity for Western firms to show their products to a large number of Soviet businessmen and experts, to make contacts, and to expand mutually beneficial trade relations. The products exhibited will be grouped as follows:

--Industrial robots and manipulators, master-slave manipulators and programmable robots, adaptive robots and sensors;

--Components for industrial robots: Hydraulic and pneumatic drives and equipment, electric drives, control units for industrial robots, software, sensors, grippers and other equipment;

--Standard manufacturing cells equipped with assembly, welding, painting, warehousing, and pallet loading and unloading robots, for general-purpose machinery and for machines usable in agriculture, building construction, metallurgy, etc.;

--Naval integrated automation, workshops and factories that utilize robots;

--CAD systems for robots, manipulators and industrial robot complexes;

--Instruments and equipment adaptable to automatic manipulators, instruments and devices for the automation of production;

--Scientific literature.

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9399
CSO: 3698/268

BRIEFS

FRG-USSR NUCLEAR REACTOR DEAL SIGNED--A collaboration agreement has just been signed by the West German group Innotech Energie from Essen to design, construct and put use a high temperature nuclear reactor (HIR). The project will cost slightly over 3 billion francs (DM 1 billion) and should have the energy output of 100 megawatts. According to the German group, the contracts detailing the problems of technology transfer, financing, and delivery will be ready in 18 months. Currently the Germans are practically the only ones in the world who have persistently continued to work on this new type of reactor, where the fuel is in the form of spheres, capable of sustaining temperatures of over 900 degrees. The whole thing is cooled by helium. The specialists expected a great deal from these high temperature reactors, particularly for coal gasification. But it has been very difficult to develop them, as evidenced by the fourteen years it took Schmehausen to perfect a West German 300 megawatt prototype, the construction of which has cost DM 4 billion. [Text] [Paris LE MONDE in French 5-6 Apr 87 p 8]

CSO:3698/372

ROMANIAN COMMUNICATION EQUIPMENT FOR METEOSAT

Bucharest FLACARA No 8, 20 Feb 87 p 24

[Article by Elena Ghera: "Pictures of the Earth Transmitted by Satellite and Received by a Superb Installation of Romanian Design and Make"]

[Text] The ground station for receiving the Meteosat geostationary meteorological satellite is used to receive and process pictures of the earth transmitted by satellite.

The Meteosat satellite, launched by the European Space Agency, is located in an equatorial orbit over Africa, by the Gulf of Guinea, at a distance of 36,000 km from the earth. From this position, the earth is seen from Brazil to the Indian Ocean and nearly from pole to pole.

The pictures are taken in three spectral bands: the visible spectrum, the infrared spectrum, and the water-vapor-absorption spectrum. These pictures are transmitted by electromagnetic waves with an approximate frequency of 1700 MHz on a preset schedule.

The main users of these data are the weather bureaus, thus having the possibility of improving the quality of the forecasts.

The satellite utilizes two forms of transmission of the pictures of the earth. The lower-resolution analog one is for recording on photofacsimile-type reproduction systems, similar to those used by press agencies, with long-distance transmission of them by telephone line after reception also being possible. The second form of transmission, the high-resolution digital one, is for specialized studies and research, for which the information gathered by the satellite is transmitted in full.

Back in the winter of 1983, the Research Laboratory for Microwave Communication Equipment at the Scientific Research and Technological Engineering Institute for Electronics in Bucharest began the research for achieving a piece of equipment for receiving the Meteosat satellite. In the summer of 1984, the station was already being used by the Institute of Meteorology in Bucharest, and on 30 December 1985, a similar piece of equipment was on the way to Potsdam, in the GDR, the first foreign customer.

The system for receiving the data and processing the data received is composed of the following parts: a parabolic antenna with a diameter of 3 meters, at the focus of which is the microwave receiver. This contains, in its turn, a very-high-frequency and low-noise amplifier, which amplifies the signal transmitted by the satellite from the distance of 36,000 km. The signal thus amplified is then lowered in frequency and transmitted to the receiver, which decodes the two forms of transmission, analog and digital. The receiver can be connected to two pieces of photofacsimile-type equipment and, by means of a specialized (linked) interface, to a computer system (an I-102 F computer), which receives the numerical data, stores them on a disk unit or on magnetic tape, processes them, and displays them for the user. The results of this processing--numerical data and pictures (black-and-white or color) of the earth or only of selected areas--represent the starting point for specifically meteorological applications programs, which are the object of research for the preparation of weather forecasts.

The receiving equipment achieved by the specialists of the Bucharest research institute provides for the simultaneous reception of all the data transmitted by the satellite, giving the users every possibility of processing the data.

By achieving the Meteosat ground station, which combines peak fields of electronics, from microwaves to sophisticated computer technology, Romania has entered the ranks of the countries--few in number--that produce space equipment.

12105
CSO: 2702/4

DEVELOPMENTS IN CSSR MOLECULAR GENETICS DESCRIBED

Prague TECHNICKY TYDENIK in Czech No 50, 9 Dec 86 p 8

[Interview with Dzenek Karpfel, director of Biophysics Institute of Czechoslovak Academy of Sciences [CSAV], corresponding member of CSAV, conducted by Blanka Brablecova: "Where is Molecular Genetics Heading"]

[Text] The development of molecular genetics, and in particular its application to the Interkomos program, is an integral part of the work of the CSAV Biophysics Institute. In the past decade molecular genetics has been the most rapidly advancing branch of the biological sciences, in large part because of an extremely effective experimental technique that has been given the general name of genetic manipulation. This interview with Zdenek Karpfel, institute director, and corresponding member of the CSAV covers the history of this development but mainly its objectives for the near future.

Molecular genetics has discovered many new, previously unknown properties of genetic material, and of the genes themselves. These include the existence of noncoding gene components, called intons, and the existence of genes that can change their location within a chromosome, which are known as mobile genetic elements or transposons. Molecular genetics has also influenced related contiguous fields in other disciplines, and speeded up their development. This has been true for physiology, and particularly for the analysis of embryo development, the study of evolution and analysis of evolutionary relationships and the relationships between many organisms, as well as in applied physiology. New procedures have become possible that are based on gene transfer either in their natural form or in a modified state, as well as new techniques for studying hereditary diseases, and diagnostic procedures based on gene analysis. Molecular genetics holds the promise for gene therapy in the future.

[Question] Molecular genetics has affected biophysics as well. How?

[Answer] This is best illustrated by two problems that we are currently working on. New techniques exist in molecular biophysics that make it possible to analyze macro-molecule conformation, the relationship between the conformation of macro-molecules and their biological function, and especially the relation between conformation and the regulation of gene expression. Our institute is working intensively on the problem of the interaction of macro-molecules using a combination of biophysical, and molecular genetic experimental techniques in conjunction with mathematical analysis.

The mathematical techniques for biophysical analysis, especially those based on computerized processing, are being used in biophysics and are making our work more efficient. Computers today are speeding up the development not only of the physical but also of the biological sciences, and along the way are opening up qualitatively new possibilities for study. These sciences could progress no further without the computer. This is especially true of biophysics.

Radiobiology is another area that is progressing at a faster pace thanks to the combination of computers and molecular genetics. In the past five years these new techniques have helped in the discovery of numerous mechanisms that damage genetic material either through radiation, contact with chemicals, or internal causes. Of particular interest and importance are research findings concerning the ways that living cells fight the damage to genetic material, the existence of various complex corrective systems that restore damaged genetic material to its original state, which genes are responsible for this, and how their sophisticated activities inside the cells are coordinated.

[Question] Your mention of Interkosmos indicates that you are cooperating with academic institutes in the USSR....

[Answer] Not only with Soviet institutes. At a time when centers of scientific development change so sharply it is important for us to recognize important new technologies and compete with the rest of the world to develop selected technologies. Because our research base is small relative to larger, more wealthy countries we must focus our efforts on the most advanced areas, not fragment our efforts too much in cooperation with other countries, especially socialist countries. Such cooperation, especially with the USSR, has a long tradition, but we must make it more effective.

[Question] Once you succeed in identifying an advanced technology with good prospects for the future this should be reflected in the work of your institute. Which of your projects has been best received, and which ones are our industries depending on?

[Answer] Our greatest success is the fact that we identified the importance of the trend that we have just discussed. In particular, it is important that complex biological phenomena be analyzed and explained at the elementary phisical and molecular level, and that computers be involved in the process. Of our specific results, I would like to call your attention to those that have been best received in foreign publications, namely new findings concerning the genetic structure of DNA, our discovery of the so-called x-structure DNA.

Other results from the molecular field relate to mobile genes and their use in constructing vectors that in turn can be used for the genetic manipulation of plants, and to explain some of the repair mechanisms for radiation damaged DNA.

In the area of the biophysics of organisms I should mention the many successes resulting from our cooperation with the USSR in the Interkosmos project. Of greatest importance perhaps is our work on the problem of heat regulations by organisms in a weightless environment. Research on the molecular genetics of bacteriophages has resulted in the development and application of new medicines

against staphylococcus infections. Research on DNA damage and repair has helped in the development of certain platinum series cytostatics, and has helped the chemical industry in developing effective, nonmutagenic growth stimulators and new, nonharmful preparations to increase the effectiveness of cotton dyestuffs.

[Question] Has it ever happened that a finding of your research has not found a practical application?

[Answer] We have developed our research program to have a practical orientation, and have pursued it in conjunction with industry and the health care sector. As a result findings applicable to these two areas have found practical use. Many years of cooperation with Lachema is now coming to fruition as well with the founding of a joint scientific production association.

[Question] What are your future plans, with Interkosmos, for instance?

[Answer] I would assume that a reader of TECHNICKY TYDENIK might be interested in the development of oxymetry and of the Oxymeter instrument. Both are related to the needs of space medicine but are also capable of use on the ground. The technology basically involves the measurement of the vapor pressure of oxygen in the surface tissues of the human organism. Space medicine is interested in this problem because this is one of the monitoring techniques that must be used in orbiting space stations. In a weightless state, apparently, hemodynamic changes can cause fluctuations in the supply of oxygen to the surface tissues of the body.

Development of a methodology for in-flight experiments began in the mid-1970s at our institute in cooperation with the Institute for Clinical and Experimental Medicine in Prague and the Health Care Technology Research Institute in Brno. By 1977 we had completed the design of a unique apparatus for conducting in-flight experiments. This piece of equipment has proven itself during the flight of our own cosmonaut, and in many subsequent flights manned by Soviet and international crews.

In view of the fact that the Oxymeter was included by the administrative officials of Interkosmos among the techniques applicable to broader medical practice we began in the Seventh 5-Year Plan to develop a new version of the instrument. The designers, A. Vacka, M.D., candidate for doctor of science, and Eng A. Sebely, designed an instrument for clinical use that is equipped with electrodes. That fulfilled this task. Several prototypes of these machines have been loaned to clinics for testing.

Clinic employees participating in the seminar of the space biology and medicine section of the Czechoslovak Biological Society in February in Brno evaluated the performance of this instrument positively and suggested that it be used in internal medicine and pediatrics, resuscitation activities, anesthesiology and radiotherapy. We have recently contacted producers and are trying to arrange to mass produce the instrument. This is another way that we can assist in accelerating the practical application of our research findings. We will continue to do all that we can to assure that our future work finds similar successful application.

9276/12859
CSO: 2402/18

END